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STRAIN INVESTIGATION RELATIVE TO GRASSES AND CLOVERS.

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Introduction.

GRASSLAND research in New Zealand is directed towards a threefold goal: (1) Knowledge of just what species of grasses and clovers fit the growth conditions* as these exist on the farm at the present time; (2) knowledge of how best we can modify or change existing growth conditions on the farm; (3) knowledge of what part strain or type selection within the species plays in the making or marring of a pasture.

Each grass and clover has what we term a habitat range, and each demands a special set of conditions in order that it may thrive. In other words, each grass and clover is an indicator of its own environmental conditions. That great mosaic grassland complex is but the grouping of ecologically alike species into large or small association types as an outcome of variation in the conditions of the habitat. The more variable the conditions throughout any one given area the more complex the mosaic; the more uniform the conditions of the habitat the less real does this mosaic become.

As regards the hill country, the writers freely admit little likelihood of rapidly changing this mosaic grassland complex, but on good arable country that can be drained, ploughed, seeded down, manured, harrowed, grazed, and managed aright there should not exist that mosaic of associations. There should not be seen rye-grass by the gateways; rough cocksfoot further afield; patchy rank growth about droppings; hollows of creeping-bent and Yorkshire fog; clumps of tall fescue, worthless brown tussocks of rushes; patches of catsear, hawkweed, field-daisy, buttercup, or pennyroyal. This mosaic of association types tells of disparity within the conditions of the habitat,

* Growth conditions may be defined as (*a*) edaphic—those appertaining to the soil, its chemical, biological, and mechanical nature, its moisture or water-laden state; (*b*) climatic — temperature, sunlight, precipitation, wind; (*c*) growth reactions and competition, and herbage utilization by grazing, ensiling, haying, burning.

and the problem is a reconditioning of those soil-types, a levelling-up of the habitat conditions, and the improving of these up to the point where perennial rye-grass and white clover automatically take up the running as the dominant species in the pasture.

While one is apt, then, to visualize the species as stable or fixed, and to assert replacement and displacement, rise and fall of association types in response to the environment, yet there is unquestionably a variation within the species—a product of the environment. Danish cocksfoot differs in colour, in form, and in persistency from Akaroa cocksfoot; Kentish wild white clover differs from both Lodino and commercial Dutch white clover; Hawke's Bay rye-grass differs in growth-form, palatability, shade of colour, and persistency from Southland rye-grass; broad red clover differs markedly in form, persistency, and time of flowering from Cornish Marl or Montgomery red clover. The question arises as to whether these variants are exploitable. Can we by strain-selection widen, as it were, the habitat range of a species?

Strain-selection has unconsciously, but none the less surely, gone on in all arable-land-farming communities in New Zealand for the last forty to fifty years. Quick-maturing and free-seeding types of rye-grass, for example, have been sown and harvested—sown and harvested, over and over again. The slower-maturing, tardy seed-producing, leafy strains have figured in lesser and lesser degree, until to-day a free-seeding, rapidly maturing, more or less annually inclined rye-grass type has been developed—the outcome of unconscious. unguided strain-selection. On the other hand, areas have remained in permanent grass here for decades, and in England for centuries. These have been subjected to an entirely different set of environmental conditions, and survival of the sward components has been determined largely by two things: (1) The ability to reseed, and (2) the ability to persist by vegetative spread, as by tillering. In the latter case, where re-establishment through reseeding is not possible, only those strains that possess the character to tiller well will survive, and thus in all probability arise long-persistent, dense-crowned, multi-tillered, leafy types—the ideal types for true permanent pasture.

Accepting variation within the species as inevitable, the question set before us is to solve for just what niche in the economy of grassland farming the species and its variants are best fitted. The question we have to solve as consumers or users of the existing commercial strains or variants is whether they are suited for the purpose on which we are bent.

The strictly arable type of farming calls largely for the annual, the quick-establishing, rapid-growing, quick-maturing short-lived types of plant. The short-rotation grassland farmer requires temporary and short-lived high-production pastures to fit this crop-rotation system, and for such pastures, again, the quick establisher, quick-growing, free-seeding, non-persistent types of grasses are in demand. For the truly permanent pasture the demand is entirely different from either of the foregoing. The one sowing is spread over a long period of production, hence cheapness of sowing is not so essential. Long-lived, leafy, multi-tillered, vegetatively reproducing species are essentially in demand. It is a question of sowing species or strains for specific conditions;

and just as it is fatal to sow true perennial rye-grass where the conditions are suitable only for, say, Danthonia pilosa, so it is equally fatal to sow a rye-grass developed for arable, temporary, or short lea conditions on country where the demand is for perennially grazed pastures of long duration. Again, the cocksfoot for rank growth conditions must be essentially a different cocksfoot from that of perennially well-grazed pastures. The stemmy, free-seed-production types which it is possible to secure under cultivation and non-stocking conditions differ in utility from those of the grazed pasture, and it is obviously wrong to use such types where perennially grazed pastures are demanded.

The same principle applies to the clovers. South European conditions of small holdings and arable farming call for the free-seeding, quick-growing, early maturing white clover and red clover. Their type of farming has evolved such strains, and for their purpose such strains may be excellent, but when we actually examine the types of white clover existing in the old pastures of Kent or of Hawke's Bay, or the types of red clover in Montgomeryshire and Cornwall, these are not the annual, free-seeding, quick-maturing, short-lived strains, but are long-lived, leafy, and multi-tillered—strains evolved to withstand the punishment of perennial stocking. They are attuned to the grazed sward environment; they rely on persistence by vegetative spread, as by tillering and by free root-development at node and crown. The crowns are protected by denseness of growth and by close proximity to the surface of the soil, and this gives shade to the base of the crown, and conserves moisture there, so that free root-formation may continue over as long a period of the year as possible. Compare such with the few-tillered, open-crowned, non-vegetatively-reproducing types of short-lived pasture plants carrying their crown well above the soil.

1. PERENNIAL RYE-GRASS.

SOURCE OF PRESENT-DAY SUPPLIES.

From the foregoing remarks it will be fairly obvious that source of origin and a knowledge of the conditions under which the crop has been grown must be our main guide in the buying of grass and clover seed for pasture work—be those pastures temporary, short-rotation, or truly permanent pastures. What concerns New Zealand most at the moment are grass and clover types suitable for true permanent pasture, and the point the writers wish specially to stress here is that those grasses and clovers must conform to types that are bred for permanent-pasture work.

Table 1 (next page) sets out very clearly the position in regard to commercial perennial rye-grass as sold in the New Zealand markets at the present time, with reference to perennial and annual types. These data show conclusively that the Italian or annual type of rye-grass is markedly in evidence in commercial lines of perennial rye-grass at present being harvested in New Zealand, and offered for sale under the name "perennial rye-grass" or simply "rye-grass." When it comes to defining the position in relation to short-lived types other than the strictly annual type

Table 1.—Strain Analyses of 827 Lines of Commercial "Perennial" Rye-grass.

Type.	Hawke's Bay (including Poverty Bay).	Sandon.	Wairarapa.	Marlborough.	Mid-Canterbury.	South Canterbury.	Southland.	Central Otago.	Imported.
Pure perennial lines ..	118	55	..	4	17	3	71	1	5
Dominant perennial lines with trace of Italian	27	17	3	5	8	..	40	3	9
Dominant perennial lines with some or much Italian	24	35	4	2	27	15	133	5	4
Mixed perennial and Italian lines—approximately half of each	2	16	3	..	28	22	49	1	1
Dominant Italian lines ..	2	2	1	1	11	43	10	..	..
Totals	173	125	11	12	91	83	303	10	19

the problem becomes a little more difficult, and some time will be necessary before definite results can be tabulated.

From evidence secured to date there is no doubt there are marked differences in growth-form, colour, and persistency between the perennial rye-grasses of varying origin, apart altogether from the Italian or annual types present. There are true perennial types and pseudo or false perennial types. The true perennial types are dark-green in colour; the pseudo-perennials are lighter in colour. The true perennial types are all flat-stemmed, with leaves in bud definitely folded and narrowly V-shaped; the pseudo-perennials are rounded in stem section, and tend to be more fleshy in the bud shoot, which is U-shaped rather than V-shaped. The tiller shoots of the true perennial become more densely packed and tend to be erect rather than prostrate; the pseudo-perennials are more sparsely tillered, laxer in the crown, and the shoots widely divergent and spread out rather than erect. These are morphological characters difficult to define, however, and the real test of the true as against the pseudo or false is that of longevity or persistency.

The origin, production, and perpetuation of these pseudo-perennial forms can be set down largely as a result of the type of farming practised and the influence of ruling climate. There seems little doubt that the Southland perennial rye-grass has a more definite winter form than the North Island perennial. This winter form may be the outcome of adaptation to the severer climate of the South, and whether the true perennials of the North are superior in the South to those of the South still remains to be definitely proved.* Certainly the true perennial rye-grasses of the North are markedly superior in the North to those equal winter

* Evidence on English rye-grass obtained at Aberystwyth (Wales) would lead the writers to suggest that this winter form bears no relation whatever to climate, but is the normal growth-form of the non-persistent, short-lived rye-grass.

forms of the South. Virtually the whole of the rye-grass of the South at present on the market is of the pseudo-perennial type; and whatever the origin of these pseudo-perennial types, whether it is due to climate, to the type of farming practised, or whether it is due to hybridization, or crossing annual and perennial types, the fact remains that these pseudo-perennial types are not suited for truly permanent pasture work.

Table 2 sets out the results of field tests under grazing on four different soil-types in the North Island. The Hawke's Bay old pasture, the Hawke's Bay maiden, and the Sandon rye-grass lots were true perennial type. The Southland is a typical blended line from that district, and the Canterbury is a typical blended perennial type from mid-Canterbury.

Table 2.—Point-quadrat Analyses on Four Different Areas sown to Rye-grass of Different Origin in Autumn of 1928.

The figures represent the percentage of ground covered by rye-grass in each mixture.

Area.	Hawke's Bay Old Pasture.	Hawke's Bay Maiden.	Southland.	Sandon.	Canterbury.
A. Analyses made two months after sowing.					
Central Development Farm, Weraroa	53	58	55	55	53
Marton	43	42	41	40	35
Katere, North Taranaki	37	45	43	35	37
Manaia (not analysed)	..	..	..	..	..
Average ..	44	48	46	43	42
B. Twelve months after sowing.					
Central Development Farm, Weraroa	79	77	26	72	9
Marton	39	46	28	45	17
Katere	52	59	12	41	4
Manaia	44	55	20	58	15
Average ..	54	59	22	54	11

These figures are extremely significant. The true perennial has made good headway and has increased markedly at the end of twelve months, whereas the pseudo-perennial (the Southland type) has decreased by more than half, and the annual and pseudo-perennial Canterbury type has virtually disappeared from the pasture. Each of these areas was laid down with 4 cwt. carbonate of lime and 3 cwt. superphosphate at time of sowing, and during the following winter were top-dressed with 3 cwt. super or slag, plus (on portions of each plot) ½ cwt. sulphate of ammonia and sulphate of potash, per acre. Even under these liberal dressings the pseudo-perennial and the annual types failed to survive in sufficient quantity to make a pasture.

It is difficult to estimate the harmful effect these pseudo-perennial and annual rye-grass types have had on the grasslands of New Zealand as a whole. So persistently have these types failed after the first year that there has arisen a large school that claims this thinning-out of rye-grass as inevitable, and maintains it were better to bring a

pasture back by manuring rather than by ploughing up and resowing. The writers maintain that much of this failure (apart from heavy smother such as is produced by red clover or too much Italian rye-grass, rape, &c.) of the pasture in the second year onwards is due largely to the use of the wrong type or strain of rye-grass. The true perennial is a "sticker"; it can withstand hard punishment and starvation conditions of a temporary nature.

The knowledge that this failure can be to a large extent avoided, and that if a genuine perennial be sown there will persist a rye-grass that will respond to manuring and pay handsomely from the time of renewal, will be far-reaching. The writers venture to suggest that just so soon as we can get back on to the market genuine perennial rye-grass at a reasonable price there will be a revival of the plough, and subsequent manuring of a turf that is worth while.

New Zealand is extremely fortunate that she has at hand a good perennial rye-grass type probably equal to any commercial strain throughout the world—the Hawke's Bay type. Not that all seed from this source is genuine perennial; but at comparatively small expense the genuine crops may be identified, and, with these as a nucleus, mother seed can be produced; and this once grown will soon furnish a sufficiency of the genuine article for all New Zealand's requirements at least. This is the urgent problem, but it must be followed up by detailed work to isolate the "super" strains, as it were, from the general mass of Hawke's Bay and other true perennial rye-grass types.

SEED-PRODUCING DISTRICTS OTHER THAN HAWKE'S BAY AND POVERTY BAY.

It must not be presumed that Hawke's Bay and Poverty Bay are the only districts in New Zealand that can produce the true perennial rye-grass seed. The Sandon district (Wellington province) contains much good perennial rye-grass practically identical with the Hawke's Bay strains, and with a small amount of work and care in the elimination of the mixed and dominant Italian and pseudo-perennial types that have crept in, this district would rapidly come back to its own as a recognized true perennial-seed producer.

There must exist also in Canterbury and Southland quite a large number of areas where truly persistent perennial rye-grass is growing, and there is always the possibility that such areas may carry strains superior even for the purposes of permanent pastures in those districts than any strain that could be introduced there. The determination of just where these true perennial strains are growing, and the harvesting of these as mother seed, is a job that must impress itself seriously upon farmers in Canterbury and Southland. At the present time seed is not produced from these old-standing perennial rye-grass pastures. They do not affect the present position, and as far as the seed on the market at the present moment is concerned they might as well not exist.

MAIDEN-SEED PRODUCTION FROM APPROVED MOTHER STRAINS.

The course it would seem desirable to take in order to put true perennial rye-grass back on to the market at a reasonable price is, firstly, to earmark areas of the correct strain, and to take seed crops from these areas, such seed to be regarded as mother seed which is set aside

for maiden-seed production. The production of this maiden seed may take place in any district that is eminently suited for seed-production, such as Hawke's Bay, Poverty Bay, Sandon, Wairarapa, Marlborough, Canterbury, Otago, and Southland. A certain amount of precaution would be necessary to preclude the possibility of volunteer rye-grass contaminating the crop, but just so long as this maiden seed is used only for pasture establishment, and not for other seed crops, a small amount of contamination with other strains is not serious if the crop is dominantly of the true perennial type. The feeling that exists against maiden seed as compared with old-pasture seed has to a large extent arisen from the fact that maiden seed is possible from any strain—annual, short-rotational, or permanent—whereas the old pasture, it is claimed, *must* represent the right long-lived type. As a matter of fact, this latter claim is true only to a certain point. As already mentioned, old pastures may persist either by reseeding and re-establishment or by vegetative tillering. It is very certain that rye-grass crops from very fertile soils which freely admit of re-establishment of seed shed do contain a high percentage of Italian rye-grass, and in some few instances dominant Italian rye-grass crops have been produced from areas that have not been broken up for the last twenty to thirty years.

This only emphasizes the importance of strain and the necessity of some guarantee as to trueness to type. To the writers it would appear that trueness to type is more important than old pasture, but certainly it is to the old pastures that we shall look, for the start at least, for the production of mother seed. Old-pasture mother seed of the correct type should give a progeny—*i.e.*, maiden seed—that is in every respect equal to itself. In other words, just so long as the parent is pure and of good type the maiden offspring will also be of the correct type. It is only when the maiden seed is itself harvested for seed, that crop sown and again harvested for seed, which in its turn is again sown and harvested for seed *ad infinitum*, that the tendency is towards perpetuation and increase of the freer-seeding, quick-maturing annual or short-lived types, which exist in small proportion even in the best old-pasture lines, to the suppression of the slower-establishing, leafy, longer-maturing, true perennial types.

It would seem highly advisable that mother-seed areas should be proclaimed in whatever district the true type of perennial rye-grass is shown to exist, and that the grower of maiden seed for pasture purposes should come back to these mother-seed areas for regular supplies of seed from which to produce the maiden seed.

It is very gratifying to the writers to know that certain seed firms have already taken up the production of maiden seed from this genuine type Hawke's Bay mother seed. Concerted action between the Department of Agriculture, the seed-grower, and the seed trade will soon right a position that was fast becoming untenable.

THE PERENNIAL RYE-GRASS POSITION IN BRITAIN.

The strain position among pasture plants in Britain as it relates to ordinary commercial grasses and clovers is not good. Knowledge in regard to strain there, however, has made considerable advance during the past decade, and there are indications that this knowledge is being actively applied by seed-merchants at Home.

The great bulk of commercial grass and clover seed used in England is still, however, of the annually inclined type, and as such is totally unsuitable for the laying-down of high-grade permanent pasture. It has been a common occurrence to find sown pastures run out badly after the second year, and attempts to retain their floristic composition at the rye-grass and white clover standard have failed even with liberal manuring. On many classes of land it is many years before a sown-down pasture will make a productive grass sward, and even so the resultant pasture carries a high proportion of flat-weeds.

In England there have long arisen two opposing schools of thought; the one strongly recommends the manure-bag as the means of pasture improvement and development; the other holds that it is better to rely on temporary grass, and to plough and resow every few years—to treat grass as an arable crop, as it were, and to replough at the point when the sown species die out completely.

In the field of seed-production a certain small quantity of perennial rye-grass is saved annually from old English pastures, but this constitutes only a minor proportion of the total rye-grass seed used each year. By far the greater proportion of rye-grass seed consumed in Britain is of the annually inclined type, similar in character to the Southland rye-grass of New Zealand. English old-pasture rye-grass is often cleaned out of wild white clover, and this is mainly of the long-lived type, dense at the crown, productive, and highly persistent. There is every indication that English old-pasture rye-grass and the Hawke's Bay rye-grass of New Zealand are equivalent forms; each is an aggregate of strains, and it is from within these old-pasture rye-grasses that the plant-breeder can isolate and fix strains which come even nearer to the pasture-plant ideal than do the aggregate strains as harvested from the old-pastures to-day.

The work of selecting the best strains out of English old-pasture rye-grass has been in progress for several years at the Welsh Plant Breeding Station. These strains have been multiplied and thoroughly tested on a wide range of soil-types, and there is no doubt of their superiority as pasture plants over other known lines. These pedigree strains are now being reproduced with a view to placing them in the hands of seed-growers, and it is hoped they will be available within a year or two. When supplies of these are procurable comparative trials as against the Hawke's Bay type will be extremely interesting here in New Zealand.

CONCLUSION.

In these days of permanent pasture, top-dressing, and management towards the rye-grass and white clover ideal, the presence of a rye-grass that can persist and respond to the treatment is more than half the battle. Practically all betterment of grassland, beyond a certain point, depends on the presence of a rye-grass that can respond. The true perennial rye-grass persists, and can withstand hard and starvation conditions for years. More rye-grass in the pasture means better winter carrying-capacity, and the possibility of shortening the low-production winter period of grassland by expensive nitrogenous manuring is largely dependent on the presence of rye-grass. Our aim in New Zealand is the "rye-white" ideal, and undoubtedly a big factor towards the attainment of that ideal is the sowing of the best procurable strains of rye-grass.

(Series to be continued.)

CONTROL OF RAGWORT THROUGH INSECTS.

EXPERIMENTAL WORK WITH CINNABAR MOTH.

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THE object of this article is to place before those interested a general account of the present position of the researches into the control of ragwort through the agency of insects.

In 1927 definite investigations into the possibility of controlling noxious weeds in New Zealand by means of insects were commenced at the Cawthron Institute.* At the outset it was decided to concentrate upon the four weeds of major importance—blackberry, ragwort, gorse, and piripiri. In the case of blackberry, gorse, and piripiri the investigations are still in the preliminary stages, but the work on ragwort has advanced to such an extent that field liberations of the cinnabar moth (*Tyria jacobaeae*), imported for the control of the weed, were made last autumn.

Although good results have been secured in other countries—*e.g.*, in the control of prickly pear in Australia—the utilization of plant-feeding insects in the control of weeds, especially of weeds closely related to economic plants, is fraught with many dangers, in that there is always a possibility of the insects in question extending their food range beyond weeds to include agricultural crops. Under the noxious-weeds control scheme, and in order to guard as far as possible against this possibility, only insects that are known to be restricted to the weeds in question, or to plants of no great economic value in their natural haunts, are selected for importation to New Zealand. The insects are then kept under strict quarantine in special insectaries until the possibility of economic plants being attacked by them under New Zealand conditions has been thoroughly tested. If this proves negative the insects may be liberated in the field, as has been done in the case of the cinnabar moth.

It must be fully realized by the farming community that the liberations of the cinnabar moth already made were merely preliminary, and only a phase of an experiment to determine the behaviour of the insect in the field under its new environment. Farmers at the present stage must not be too optimistic concerning the control of ragwort by this insect, and must still actively continue to check the weed by cutting or by other means at their disposal, until it can be definitely shown that the insect will act as an efficient controlling factor. Unfortunately, too much publicity has been given to the possibilities of weed-control by means of insects; and any one believeing that ragwort, or any other weed, will suddenly disappear as soon as an insect is liberated will stand

* During the first year (1927) the noxious-weeds control research was under the direction of Dr. R. J. Tillyard who initiated the scheme, and he was followed by the present writer in 1928. Mr. A. L. Tonnoir, Field Entomologist, has been responsible for carrying on the researches since the inception of the scheme. Our thanks are due to Mr. A. H. Cockayne, Director of the Fields Division of the Department of Agriculture, for placing his field staff at our disposal in the *distri* bution of the cinnabar moth.

to be deeply disappointed. The most that can be expected of any practicable means of control is to sufficiently check, but not exterminate.

HISTORICAL.

Of the several insects found attacking ragwort in Europe and Great Britain, the caterpillar of the cinnabar moth was selected as giving most promise as a means of controlling the weed in New Zealand. Its normal food plants are groundsel and ragwort, and in its natural haunts it sometimes occurs in epidemic form, when it clears large areas of the host plants. Furthermore, the insect is normally attacked by some nine or ten parasites, which tend to keep it from developing abnormally; but before it is liberated in this country these parasites are eliminated, so that the insect should have every opportunity of increasing to a far greater extent in its new environment than it would in its country of origin.

FIG. 1. (*a*) CINNABAR MOTH; (*b*) MAGPIE MOTH.
[*Photos by W. C. Davies.*

As the caterpillars of moths pass through a dormant chrysalis or pupal stage before developing to the perfect insect, advantage of this was taken in transporting the cinnabar moth, the pupal period of which is a lengthy one. During the years 1927 and 1928 several consignments of the pupæ were secured by Dr. A. D. Imms, of the Rothamsted Experiment Station, and sent to New Zealand in cool store, and this method of transport has proved a success. An unsuccessful attempt was also made to send the eggs of the insect in cool store. From the pupæ, moths later developed in the quarantine insectaries at Nelson, and in due course a supply of caterpillars, used for carrying on the research, was secured from the eggs laid by these moths.

Although the cinnabar moth caterpillars are not known to attack plants of economic value in Europe or Britain, it was nevertheless necessary to submit the insect to a series of starvation tests in New Zealand before considering the question of liberation. Except in the case of ragwort, groundsel, and cineraria, these tests proved negative, and an official permit from the Government was given authorizing liberation. However, owing to later reports received from England, some doubt existed as to whether the larvæ would attack potatoes,

although the tests already made in Nelson had proved negative. In view of this, liberation in New Zealand was postponed until further and more detailed tests with potatoes had been carried out both at Nelson and at Rothamsted in England. These tests again showed that the insect could not survive on potatoes, and liberation was proceeded with.

FIG. 2. CINNABAR MOTH AT REST ON RAGWORT.

[Photo by W. C. Davies.

DESCRIPTION OF THE CINNABAR MOTH.

The moth (Fig. 1 *a*), which measures about ¾ in. long when the wings are closed, is black in colour with crimson wing-markings; the forewings are black with a crimson stripe along the full length near the fore margin, and two crimson spots close to the outer margin, while the hindwings are completely crimson with a narrow black margin.

FIG. 3. EGGS OF CINNABAR MOTH ON RAGWORT LEAF.

[*Photo by W. C. Davies.*

The eggs are globular, and laid in clusters on the underside of the leaves of the food plant (Fig. 3); they are yellowish in colour at first, but turn to brownish in a few days.

The caterpillar (Figs. 4 and 5 *a*) is distinctly marked with alternating broad blackish and narrow orange bands, and is sparsely clothed with long pale hairs; when fully fed it measures about 1 in. long.

The chrysalis or pupa (Fig. 5 *e*) is rather plump and about ½ in. long; it is more or less blunt at both ends, reddish to blackish-brown in colour, and is sometimes enclosed in a loosely spun silken cocoon.

LIFE-HISTORY.

Under summer conditions the eggs (each female moth laying about 150) hatch in about eight days, just prior to which they change in colour from yellowish to brownish. The caterpillars grow rapidly as they

devour the plants; during growth they pass through five stages, each stage being separated by a short quiescent period during which the protecting "skin" is moulted and replaced by a more roomy one to accommodate the growing insect. These moultings are accompanied by certain changes in colour: the minute freshly emerged caterpillar is yellowish except for the black head; in the second stage of growth (*i.e.*, between

FIG. 4. CATERPILLARS OF CINNABAR MOTH FEEDING ON RAGWORT.
[*Photo by W. C. Davies.*

the first and second moults) the colour is almost black, later turning to orange with black dots over the body; in the third stage (*i.e.*, after the second moult) the characteristic alternating orange and black bands make their appearance and persist through the fourth and fifth stages. The caterpillar takes about four weeks to complete its growth under summer conditions.

At first the young caterpillars are gregarious, feeding in colonies; but as growth proceeds they commence to wander and spread in all directions over the area covered by the food plants. Both leaves and flowers are devoured, the insect showing a preference for the latter. When fully fed the caterpillars do not burrow into the ground, but wander to some sheltered spot among the debris about the base of the

plants, or into crevices, or under lumps of earth or stones, where each may spin a very imperfect cocoon of silk, and there, passing through a final moult, transform to the pupa. The pupal stage is a prolonged one, and the insect passes the winter as such, the moths not emerging from the pupæ until the following spring.

FIG. 5. (*a*) CATERPILLAR OF CINNABAR MOTH; (*b* AND *c*) CATERPILLARS OF MAGPIE MOTH (CLOTHING OF HAIRS INDISTINCT); (*d*) PUPA OF MAGPIE MOTH; (*e*) PUPA OF CINNABAR MOTH; (*f*) RAGWORT-STEMS DAMAGED BY MOTH STEM-BORER.

[*Photos by W. C. Davies.*

In Europe and Britain the cinnabar moth develops through only one generation each year, the moths appearing in the spring and during summer, when the caterpillars become abundant; in the autumn and winter pupation is at its height. Under New Zealand conditions it is hoped that two generations may develop, when the insect would certainly be a much greater factor in the control of ragwort.

LIBERATION OF THE INSECT IN NEW ZEALAND.

On 11th February, 1929, field liberations of the cinnabar moth in New Zealand were commenced, it being found most convenient to distribute the insect in the egg stage. In order to secure the supplies of eggs, fertilized moths were placed in muslin cages enclosing ragwort growing in the Cawthron Institute grounds (Fig. 6), and later the leaves upon which the eggs were deposited (Fig. 3) were removed and distributed in tin boxes. Altogether some 500,000 eggs have been

distributed at the following points: Cawthron Institute grounds, and in the Te Puke, Hamilton, Stratford, and Invercargill districts.

It was not intended that these liberations should be made to all ragwort districts of the Dominion, but only to selected areas, in order to ascertain the effect of the insect upon ragwort, and its manner of

FIG. 6. SHOWING MUSLIN CAGES USED IN CAWTHRON INSTITUTE GROUNDS IN SECURING EGGS OF CINNABAR MOTH FOR DISTRIBUTION.

[*Photo by A. L. Tonnoir.*

behaviour under field conditions where it would be exposed to the influence of its new environment. However, it is intended to make more widespread distribution of the insect next spring,* and with this in view a supply of several thousand cinnabar moth pupæ is expected to reach the Dominion in time for the liberations to be made. This supply is being secured by Dr. W. R. Thompson, of the Imperial Bureau of Entomology, London, who has now taken charge of the European end of the noxious-weed control work.

OTHER INSECTS ATTACKING RAGWORT.

In New Zealand there are at least five species of insects that, as larvæ, normally attack ragwort, but none of which actually serves as a sufficiently permanent means of control, though at times the weed may be temporarily checked by one or more of them. These insects

* Distributions will be made through Fields Division officers of the Department of Agriculture located in the different ragwort areas, and not direct from the Cawthron Institute to farmers.

are the magpie moth (*Nyctemera annulata*), two species of moth stem-borers (*Homoeosoma farana ria* and *H. vagella*), a fly pith-borer (*Agromyza* sp.), and a leaf-miner (*Agromyza affinis*).

The magpie moth and its black hairy caterpillars are common features of the countryside. As this insect has already been thought by many farmers to be the cinnabar moth, a description is given herewith. The moth (Fig. 1 *b*) is somewhat larger than the cinnabar moth, and is black except for a pair of white or cream-coloured spots on the forewings, a single one on each of the hindwings, and orange-yellow bands on the abdomen. The globular eggs are placed on the underside of leaves, but, unlike those of the cinnabar moth, are pale-green at first, turning to yellow and finally to a leaden colour. The full-grown caterpillar (Fig. 5 *b*, *c*) measures about 1½ in. long; it is black with narrow brick-red lines along the body which is clothed with tufts of long blue-black hair, each tuft arising from a blue-black tubercle. When freshly emerged from the eggs the caterpillars are pale yellow in colour with a black head, and the body clothed with black hairs, while the tubercles supporting the hairs turn black after a few hours, giving a spotted appearance to the body. A few days later the yellow markings appear, and the characteristic features of the fully grown caterpillars become apparent. Winter is passed in the caterpillar stage. Before pupation a conspicuous cocoon of silk is spun, the caterpillars sheltering for this purpose in locations similar to those taken up by the cinnabar moth. The pupa (Fig. 5 *d*) is about ¾ in. long, and more pointed at the posterior end than that of the cinnabar moth; it is yellowish at first, but later becomes blackish and mottled, the abdomen being conspicuously ringed with orange-yellow, though in older pupæ these markings disappear. The magpie moth may undergo three or four generations during the year.

The magpie moth is common every year, and periodically becomes epidemic, when it acts as a severe check to ragwort. However, these epidemics are not of sufficiently frequent occurrence to be of permanent economic value. One of the factors controlling this insect is that of parasites, there being two common species, *Ecthromorpha intricatoria* and *Phorocera casta*.

The two species of moths breeding in the stems of ragwort are well established throughout New Zealand; they occur also in Australia, and possibly in the Pacific islands. Some seasons they occur in localized epidemic form, when they act as temporary check to their host plant. Like the magpie moth, they are controlled by parasites. The damage they do to ragwort is shown in Fig. 5 *f*).

The larvæ of the fly pith-borer and of the leaf-miner are usual associates of ragwort, but do but little appreciable damage, if any, to the plant.

PROSPECTS OF RAGWORT-CONTROL BY THE CINNABAR MOTH.

In the insectaries the devastating effect of the cinnabar moth was extremely apparent, and if this condition could be maintained each year in the field one could safely say that ragwort would no longer rank as a major weed. But under field conditions the insect enters a complex of factors any one or all of which might be so detrimentally

influential as to prevent it from maintaining a standard sufficiently epidemic for effective control. Among such possible detrimental factors are climate, natural enemies, and disease. Regarding climate, one should expect that the meteorological conditions of New Zealand would be rather favourable than otherwise, especially in the North Island; in Southland, on the other hand, the greater severity of the climate will probably have a staying influence upon the insect.

Of possible natural enemies predaceous and parasitic insects will certainly influence the problem. Even at this early stage of establishing the insect it has been found that the two parasites attacking the early stages of the magpie moth are both parasitic upon the cinnabar moth. To what extent these parasites will affect the general issue is not yet known.

The disease factor is not to be overlooked, since in the insectaries a polyhedral disease destroyed a very great proportion of the caterpillars. In the insectary, however, conditions were favourable to the development of this disease, owing to overcrowding and high temperature and humidity. It is hoped that similar epidemics will not destroy the cinnabar-moth caterpillars under open field conditions, although the writer has noted a somewhat similar disease destroying large numbers of the army-worm caterpillar (*Cirphis unipunctata*) during an outbreak of the latter.

NOTE.—The foregoing article will also appear in the *New Zealand Journal of Science and Technology*.

IMPERIAL BUREAU OF SOIL SCIENCE.

THE Imperial Bureau of Soil Science (one of the eight bureaux the formation of which was recommended by the Imperial Agricultural Research Conference of 1927) commenced work on 1st May last at the Rothamsted Experimental Station. Sir John Russell, Director of Rothamsted, is also the Director of the Bureau, and Dr. A. F. Joseph, lately Sudan Government Chemist, has been appointed Deputy Director. The functions of the Bureau include the collection and distribution of all research work on soils of importance to the British Empire; the assistance of research workers in the prosecution of their investigations in whatever ways the Bureau can give it; the bringing together (either by correspondence or in conference) of workers from different parts of the Empire interested in the same subjects; and the supply of information generally which may facilitate the work of soil experts in the development of agriculture.

It is hoped that before long the Bureau will be in close touch with all soil investigators of the Empire, both at home and abroad, and that by means of information-circulars and other methods the results of studies carried on in one part of the Empire will be made available for all. Arrangements will also be made to supply information dealing with soil investigations in foreign countries, the results of which (owing to language or other difficulties) are not readily available.

Certified Seed Wheat.—At last month's meeting of the Committee of the Wheat Research Institute Mr. J. W. Hadfield, Agronomist, Agriculture Department, reported that there had been a marked increase in the amount of wheat offered for certification, and that the standard required for certificate had been raised. An aggregate of almost twelve thousand samples of Tuscan and Hunter's wheat had been certified during the past season, and all of this had found a ready sale, so that a greater area than ever of standardized seed was being sown for the 1929–30 season.

MINERAL CONTENT OF PASTURES RESEARCH.

REPORT ON WORK IN NEW ZEALAND FOR YEAR 1928–29.

B. C. ASTON, Chief Chemist, Department of Agriculture.

Introduction.

THE following matter is the substance of an official report made by the writer in his capacity of Director of the New Zealand section of the research, supported by grants from the Empire Marketing Board, into the mineral content of pastures.

The work for the past year has provided additional evidence that where deficiency diseases in stock occur it is not possible to tell by mere inspection of the pasture whether it will or will not support stock in a healthy condition over lengthy periods, although stock may be kept healthy and even, under certain conditions, fattened if the period of grazing is restricted to a few months.

The three outstanding instances of this deceptive nature of the pasture are (*a*) "bush sickness," or iron starvation in sheep and cattle; (*b*) "dopiness" in sheep, or calcium starvation; (*c*) "Waihi" disease in cattle, or phosphorus starvation. (It is possible that this phosphorus deficiency may occur in sheep also in some localities.)

The "bush-sick" pasture has not only misled hundreds of practical farmers by its apparent normality and luxuriance of growth, but quite recently two eminent British authorities have failed to *see* anything abnormal in the appearance of the pasture.

The Mairoa "dopiness" pasture after treatment with a calcium salt is still a poor-looking feed, yet the addition of calcium has enabled a flock of young sheep to be maintained in health for eighteen months where previously the mortality would have been heavy.

Some cow-pastures in the upper Wairarapa district carrying a fair proportion of clovers and having good lime percentages are yet extremely deficient in phosphorus—none worse, indeed, has yet been found in New Zealand. Other areas are affording similar evidence, but sufficient work has not been done to enable much to be said on the composition of their soils or pastures.

The remedy for each of the three troubles in stock mentioned is different, but it may be at once said that as all North Island soils are deficient in phosphate and give a liberal growth-response to phosphatic treatment, each of these deficiency diseases is benefited to a certain extent by phosphate dressings. Indeed, it would be an extraordinary thing if it were not so, seeing that phosphates have such a stimulating action on all plant-life—increasing the root-development and the consequent ability of the plant to search further afield for plant-food, and increasing the proportion of clovers in the pasture, thereby increasing the calcium content. Also it must not be forgotten that in the case of superphosphate other mineral foods besides phosphorus are supplied, chiefly calcium sulphate (supplying Ca and S), while in the case of basic slag there are supplied iron, manganese, silicon, calcium, and magnesium. All deficiency areas are therefore likely to respond to liberal phosphatic manuring, and

especially to treatment with a basic slag and superphosphate mixture in equal amounts. It may be noted that basic slag is the only commercial phosphate which contains iron in appreciable quantity.

There can be no doubt as to the correct method of combating deficiency disease under New Zealand conditions, where the deficient element would benefit both the yield or feeding-value of pasture and the health of the stock. In Waihi disease, therefore, undoubtedly treatment of the pasture by top-dressing with phosphates is indicated as sound policy, although to obtain quick results superphosphate in drinking-water, unsteamed bone-licks, and syrup of phosphate-of-iron drenches are for cattle undoubtedly efficacious remedies. In regard to calcium deficiency, there are cases where the application of lime or calcium salts does not increase to the same extent as phosphates the carrying-capacity of the pasture (Wallaceville experiments gave evidence to the contrary), yet it undoubtedly makes it more palatable and has a great influence in rendering stock more resistant to disease; therefore calcium salts or lime may well be advocated as a pasture-dressing. The administration of a lick to combat calcium deficiency is still in the experimental stage.

With regard to elements lack of which is responsible for malnutrition or deficiency diseases in stock, and which do not increase the yield and carrying-capacity of the pasture, such as sodium, iron, chlorine, and iodine, it seems probable that it will generally be found economic in cases where any such element is deficient for animal life to give it to the stock direct as a lick or drench, or dissolved in the drinking-water. It is doubted by some plant physiologists whether chlorine is essential to plant-growth, and the doubt about iodine must be greater still, seeing that all the elements known to be essential to plants have low atomic weights ranging from 1 (hydrogen) to 56 (iron), whereas the atomic weight of iodine is 127. Iron is required in such small amounts for *plants* that all soils, with very rare exceptions, contain sufficient, but the animal requires iron in much greater amount. It is an established practice in agriculture to give sodium and chlorine to the animal direct as a lick. It will therefore be both economical and logical to give iodine and iron as a lick in cases where it is desirable to supplement that of the food-supply. Indirect methods such as increasing the humus, thus reducing leaching and loss of plant foods, and supplying phosphates and nitrates containing the deficient element as an impurity, may when practicable be found effective.

One of the greatest difficulties met with in the progress of this investigation has been that of obtaining samples of pasture which adequately represent what the animal is actually eating. The most misleading results may be obtained from pasture gathered in the field on which stock are actually grazing. The tendency in the inexpert sampler is to obtain samples of what the animal is *not* eating, for it is precisely that portion which is the most easy to obtain. Instructions have therefore been given to exercise the utmost care to collect only portions of pasture which shows signs of having been bitten by the grazing animals. While this task is likely to be satisfactorily accomplished with care in the case of cow pastures, it will probably be extremely difficult in the case of sheep pastures where the animals have the range over a large area of broken country and have reduced the area grazed to a very closely cropped lawn.

The writer hopes to evolve a system eventually that will enable proper samples to be obtained with certainty, but one of the first steps in attaining a reasonable degree of accuracy in this important part of the work is the delegation of the duty of all pasture-sampling to one officer and his assistant. Mr. R. E. R. Grimmett, of the writer's staff, has devised a special instrument for obtaining samples from short lawn-like pasture. This is merely a pair of horse-clippers with the alternate prongs removed, the sample being cut by applying the reverse side of the clippers to the surface of the soil. Some of the pastures in Central Otago are so bare in spring that even this device may fail and other methods have to be adopted.

It will be convenient to report the work undertaken during the year in the order given, disposing first of the investigations more recently taken up and which have at present only reached an initial stage, although it is possible that any one may develop into something much more important than the amount of work done would suggest.

Mortality among Sheep in Canterbury.

Mr. Grimmett visited various localities in Canterbury in September, 1928, and collected samples and information on an unusual mortality in sheep which had occurred there. The abnormal nature of the season—a warm and exceptionally moist autumn—had induced a copious growth of green rank pasture upon which the hoggets failed to thrive. A sample from Kowhai Bush was first received in June from the district Stock Inspector, and proved to be separable into two fractions—(1) a brown, long dead, and apparently inedible portion when collected and (2) a portion which was green, not long dead, and edible. The amount of portion (1) equalled 75 per cent., and that of portion (2) 25 per cent. of the whole. The analysis of the portions was done in duplicate, and the duplicates closely agreed as shown in Table 1.

It will be seen that the calcium is comparatively high in both fractions, but there is a great disparity between the phosphoric acid content of the brown fraction compared with that of the green fraction. The brown fraction represents probably old dead leaves which had lived sufficiently long to have accumulated a large store of earthy contamination, hence the high manganese, iron, silica, and alumina content as compared with the green sample. The nitrogen in the brown portion makes a very poor showing for protein-supply. Altogether it was very much doubted whether the sample was a fair one of what the sheep were eating. It will also be noted that the dry dead portion contained less than one-half the phosphoric acid that the green portion contained, although the calcium content was little altered.

Mr. Grimmett reported as follows :—

It appears that mortality from parasitic gastritis and lungworm was fairly prevalent over most of Canterbury among hoggets and lambs during the autumn (1928), and that medicinal treatment had very little effect.

Districts specially affected were Springfield, Ashburton, Cheviot, and Methven, including both hill and plain country, heavy and light, and manured as well as unmanured land. The lower foothills and damp ground beneath them were, however, the worst. Nothing similar has

Table 1.—Analyses of Pasture, Kowhai Bush.

The figures are percentages on the moisture-free sample.

Constituents.	Portion 1.		Portion 2.	
	No. 6148, Dry A.	No. 6148, Dry B.	No. 6148, Green A.	No. 6148, Green B.
Total ash	9·88	..	11·34	..
Crude silica	5·66	5·65	3·57	3·56
Pure silica (SiO_2)	5·54	5·52	3·51	3·51
Calcic oxide (CaO)	0·80	0·80	0·67	0·67
Phosphoric anhydride (P_2O_5)	0·28	0·28	0·72	0·72
Ferric sesquioxide (Fe_2O_3)	0·044	0·042	0·028	0·029
Magnesic oxide (MgO)	0·31	0·32	0·40	0·44
Manganoso manganic oxide (Mn_3O_4) ..	0·070	0·066	0·036	0·041
Alumina sesquioxide (Al_2O_3)	0·043	0·046	0·016	0·025
Nitrogen	1·30	1·30	2·95	2·96
Sulphur trioxide—present in crude silica ..	0·26	0·26	0·48	0·54
Ferric sesquioxide	0·0016	0·0014	0·0014	0·0011
Alumina sesquioxide	0·045	0·048	0·016	0·016
Calcic oxide	0·003	0·004	0·001	0·002

NOTE.—Explanatory details of procedure and technique followed in connection with analyses of pastures will be found in the issues of this *Journal* for January and February, 1928.

been said to have occurred for twenty years. It was generally stated that the past autumn was marked by an absence of drying north-west winds, and by a prevalence of drizzling rain and damp days, although rainfall was not above normal. In consequence, from March onwards there was an unusual lush growth of grass of a sappy nature, which went rank and to seed quickly. Lambs which had been grazing on high country in many cases during the summer were brought down to winter on this pasture, which included an unusual proportion of dead or dying growth of low nutritive value. Their condition was thereby weakened and they were an easy prey for parasites. In other cases the sheep had been on the place all the time, but it rapidly became understocked in relation to this rank autumn growth. In other cases, again, sheep were affected on turnips. The most effective treatment was a change to hard feed, such as feeding crushed oats on a bare paddock.

There is no doubt that the sheep did eat this rank growth, as the ground on F.'s property where M.'s sample was obtained is now bare and very hard grazed. No cattle have been grazing there, nor has it been burned.

In the Springfield district the three largest farmers who had trouble were F., J., and D. D. commenced feeding iodized salt liberally, and says it has cured the trouble. Nevertheless the trouble has now disappeared, with the exception of an odd case, on other farms where no iodine has been given. D. is very keen on the improvement caused by the iodized salt. F.'s sheep were brought down in the autumn from his station at Bealey, while J.'s were running on the lower slopes of Mount Torlesse before being brought in to turnips and the adjacent flats where the rank pasture was growing. F.'s property was originally southern-beech (*Nothofagus*) forest, and was felled and grassed thirty-five years ago. Since then it has been continuously stocked, and on the hill slopes has had no manure.

Table 2.—Analyses of Pasture Samples from Canterbury (Sheep Mortality Investigation).

The figures are percentages on the moisture-free sample.

Lab No.	Ash.	Crude Silica (SiO_2).	Pure Silica (SiO_2).	Ferric Oxide (Fe_2O_3).	Alumina (Al_2O_3).	Phosphoric Acid (P_2O_5).	Calcic Oxide (CaO).	Magnesic Oxide (MgO).	Manganese Oxide (Mg_3O_4).	Nitrogen.	Proteins.	Sulphur as SO_3.	Chlorine.	Date collected.	Manurial Treatment.	Locality.	Remarks.
6148	9·98	5·74	5·32	0·042	0·118	0·44	0·70	..	0·049	..	..	..	..	10/6/28	..	Kowhai Bush	..
6165	10·07	4·70	4·15	0·035	0·065	0·77	0·81	0·31	0·041	2·87	17·94	..	0·68	6/9/28	..	,,	Sheep affected. Short feed, eaten hard down.
6166	8·57	3·08	2·88	0·033	0·054	0·85	0·79	0·39	0·052	3·86	24·13	0·64	0·64	7/9/28	Unmanured	,,	Sheep affected on old pasture; green new growth where grazed. Mostly fog, cocksfoot, and creeping-fog; fair amount of red clover.
6167	5·89	3·81	3·54	0·024	0·033	0·37	0·52	0·19	0·063	1·35	8·44	..	0·18	7/9/28	,,	,,	Sheep affected; rank grass. Mostly fog, &c., as No. 6166.
6168	9·63	3·66	3·20	0·082	0·135	0·94	0·77	0·37	0·050	4·20	26·25	..	0·58	7/9/28	,,	,,	Mortality not noticed. Short green pasture, well grazed with cattle and horses as well as sheep. Contaminated with dirt by heavy stocking. Worm-casts very plentiful. Cocksfoot and fog dominant.
6169	8·38	6·47	5·13	0·041	0·054	0·22	0·29	0·20	0·030	1·24	7·75	..	0·28	7/9/28	..	Near Burnham	Old stubble field where hoggets took ill after three months. Poor pasture—nearly all hair-grass twitch, brown-top, and fescue; no clovers; Scotch thistles. Poor, dry, stony soil. Hoggets still grazing.
6170	8·58	5·11	4·51	0·038	0·048	0·42	0·51	0·32	0·092	2·43	15·19	..	0·43	7/9/28	Unmanured	Between Darfield and Springfield	Mortality among hoggets. Swamp paddock; fair sole of grass; alluvial flats near stream; mostly brown-top and twitch.
6171	9·76	3·19	2·93	0·071	0·098	0·80	0·75	0·50	0·066	3·53	22·06	..	0·90	7/9/28	2 cwt. super in 1927	Ditto	Mortality. Swamp paddock, well grazed; mostly young fresh growth—brown-top, white clover, &c.

Samples (except No. 6148) collected and analysed by R. E. R. Grimmett.

NOTES.—It will be seen that the phosphoric acid and lime contents of No. 6169 from where the hoggets became affected is exceptionally low. No. 6167 is little better, while No. 6168, from where no mortality was noticed, contains much higher amounts of both the constituents mentioned. The high alumina content of several of the samples shows that they were contaminated by earthy matter. It must not be forgotten that, excepting the first, all the above are early spring pastures.

Yet the grass still keeps a fairly good heart, and F. states carries two sheep to the acre all the year with the help of hay and turnips. Both F.'s and J.'s properties are partly on alluvial terraces and partly on hill slopes of residual soil from greywacke rock, which outcrops, forming screes. The soil is loamy, with a loamy, clayey, or rocky subsoil. The pasture is mixed, and varies from place to place. Tussocks are abundant, but between is a good sole of cocksfoot, brown-top, fog, fescue, &c. White clover is present, and is said to be fairly abundant during the summer. There is moss in places, but the property is 1,200 ft. above sea-level.

The results of the analyses of Mr. Grimmett's samples are presented in Table 2. Readers in the Northern Hemisphere must remember that in New Zealand, where the seasons are reversed, June is midwinter.

Temporary Sterility in Dairy Cows, Waikato District.

Mr. Grimmett visited the Waikato in October, 1928, and in company with Mr. C. M. Wright, Country Analyst, and Mr. C. V. Dayus, Veterinarian, collected samples of pasture from typical farms upon which temporary sterility in dairy cattle occurred, and also from farms apparently similarly circumstanced upon which no sterility occurred. The results (Table 3) do not show any constant chemical difference in the pasture of the two types of farms. The high protein content of the pasture of all the farms is notable.

These Waikato samples seem to indicate that low lime content follows low legume composition. The protein content is generally high, and in some cases very high. The majority of the samples are obviously contaminated by soil, as shown by the high alumina content, the only samples showing any approach to freedom from this impurity being Nos. 6192 and 6195. The iron determination must therefore not be accepted as representing the analysis of the pasture tissue.

Malnutrition on certain Poverty Bay Back-country Pastures.

The few analyses made of the Poverty Bay back-country pastures (Table 4) give evidence of both iron and calcium shortage for these early spring pastures; summer pastures would contain more calcium. Mr. Grimmett, who has paid two visits to this area, which is remote from headquarters and difficult of approach, has put forward a very ingenious explanation to account for the occurrence of this type of malnutrition under conditions which do not accord with past experience. It appears that on the same farm there are two types of country—flat tablelands overlain by pumice showers, and steep papa slopes and gullies from which the pumice has been washed, or, at any rate, so mixed with clay that a loamy soil results. When cattle and sheep were grazed together the cattle kept the steep slopes and gullies free from scrub, fern, and "second growth," and enabled the sheep to graze on land with the cattle and thus balance their mineral diet. Grazing by cattle becoming unprofitable, it was discontinued, with the result that the gullies became blocked by tall woody growth or bracken-fern, the sheep were excluded, and thus, the means of balancing their mineral ration denied them, the malnutrition appeared. A scheme of experiments has now been laid down which will determine whether top-dressing will overcome, as seems probable, the difficulty, which is one that does not occasion any anxiety as to the ultimate successful utilization of this fine country.

Table 3.—Analyses of Pasture Samples from Waikato District (Temporary Sterility Investigation).

The figures are percentages on the moisture-free sample.

Lab. No.	Ash.	Crude Silica (SiO_2).	Pure Silica (SiO_2).	Ferric Oxide (Fe_2O_3).	Alumina (Al_2O_3).	Phosphoric Acid (P_2O_5).	Calcic Oxide (CaO).	Magnesic Oxide (MgO).	Manganese Oxide (Mn_3O_4).	Nitrogen.	Proteins.	Grasses.	Legumes.	Weeds.	Date collected.	Manurial Treatment.	Locality.	Remarks.
6186	10·74	2·24	2·07	0·035	0·122	1·03	1·20	0·53	0·032	4·71	29·4	71·3	24·8	3·9	5/10/28	Previous years, super, slag, and potash. 1927, 4 cwt. super per acre. 1928, 1 cwt. super 1 cwt. sulphate of ammonia	Hairini, Te Awamutu	Sterility 40 50 per cent. of herd. Old grass paddock; short feed. Undulating country. Subterranean and white clover, trefoil and rye-grass dominant.
6187	11·22	2·51	2·34	0·046	0·156	0·95	1·20	0·49	0·030	4·23	26·4	64·4	25·0	10·6	5/10/28	Manured annually for last six years with 2 cwt. super, 2 cwt. lime, and a little potash salts	Hairini, Te Awamutu	No sterility. Good short pasture—white clover and trefoil dominant. Grazed by cows. Fifteen years in pasture. Undulating country.
6188	11·17	2·57	2·35	0·060	0·201	0·89	1·18	0·51	0·023	4·33	27·0	63·1	30·2	6·7	5/10/28	June, 1926, Clark's Favourite mixture. April, 1927, 2 cwt. super, 1 cwt. potash. May, 1928, slag, super, and potash, 4 cwt.	Hautapu..	Good deal of sterility. Old grass paddock. Subterranean and white clover, trefoil, cocksfoot, rye-grass, and timothy dominant.
6189	11·07	2·05	1·88	0·049	0·184	1·05	0·91	0·36	0·019	4·49	28·1	78·1	15·0	6·9	5/10/28	2½ cwt. super and guano, equal parts, for some years. February, 1928, 4 cwt. lime	Hautapu..	Practically no sterility. Long grass grazed by cattle. Rye-grass dominant.
6190	10·48	2·06	1·89	0·131	0·323	0·82	0·98	0·48	0·045	3·76	23·5	82·8	15·9	1·3	5/10/28	March, 1928, 2½ cwt. super. March, 1927, 3 cwt. super. March, 1926, 2½ cwt. slag, ½ cwt. kainit	Koromatua	Great deal of sterility. Unlimed, low, swampy paddock; four years old. Long growth; grazed by cows; rye-grass dominant.
6191	12·17	3·04	2·80	0·062	0·314	0·99	1·16	0·41	0·034	3·62	22·6	85·1	12·6	2·3	4/10/28	Super and lime, slag and kainit, alternate years, 3 cwt. August, 1928, 1 ton ground limestone	Koromatua	Limed paddock, low-lying and swampy; ten years old. Cows grazing. Close cropped, and dirtier than No. 6190. Rye-grass dominant.
6192	12·15	2·53	2·44	0·030	0·043	1·02	1·08	0·48	0·026	4·34	27·1	81·2	14·9	4·0	4/10/28	Recent years slag, super, and kainit, 3 cwt. 1928, 3 cwt. super and some White Island product	Matangi ..	Little sterility. Unlimed. Ten years in grass; cocksfoot dominant.
6193	11·57	2·38	2·25	0·042	0·080	1·00	1·14	0·45	0·018	4·26	26·6	77·4	20·2	2·3	4/10/28	Similar to No. 6192, but limed	Matangi ..	Limed paddock; rank and luscious growth; cocksfoot, rye-grass, trefoil, and white clover dominant.

6194	10·54	2·52	2·33	0·082	0·198	0·77	0·71	0·45	0·673	4·11	25·7	89·9	6·2	4·0	6/10/28	Top-dressed once with 3 cwt. super, once with 3 cwt. super and guano, twice with 4 cwt. slag. No top-dressing, 1928	Orini, Taupiri	Great deal of sterility, vaginitis, abortion, and bone-chewing. Swampy paddock, clay soil on peat. Fog, rye-grass, and timothy dominant. Six years in grass.
6195	11·50	3·11	2·83	0·029	0·066	0·96	0·55	0·60	0·042	4·43	27·7	92·1	5·1	2·8	6/10/28	Never top-dressed nor limed	Orini ..	No sterility, but some abortion. Peaty soil, short-grazed by sheep between heavy growth of rushes. Fog, rye-grass, cocksfoot, timothy, Poa pratensis dominant.
6196	12·10	3·16	2·94	0·048	0·108	1·06	0·81	0·40	0·036	4·33	27·0	90·9	7·2	1·9	6/10/28	Top-dressed annually with lime and super (2 : 1), 3 cwt; and last two years biannually with 2½ cwt. basic slag	Tauhei (on Taupiri–Morrinsville road)	Eclampsia badly in 1928. Down to pasture fourteen years. Rye-grass dominant. Undulating country.
6197	10·01	2·12	..	..	..	1·06	0·65	..	0·037	3·48	21·7	98·9	0·9	0·3	6/10/28	Lime, super, and basic slag annually. 1928 basic super and blood-and-bone. Last autumn, 1 cwt. No. 1 White Island product and 2 cwt. basic super	Tauhei ..	Undulating country. Cropped for hay last five years. Mostly meadow-foxtail in flowering stages.
6198	12·99	3·61	3·42	0·063	0·215	1·16	0·56	0·46	0·032	1·01	25·1	98·8	0·7	0·6	6/10/28	Top-dressed annually last seven years with lime and super	Tauhei ..	Eclampsia experienced. In grass eighteen years. Long rank growth, grazed by cows. Mosfly rye-grass, meadow-foxtail, timothy, cocksfoot, fog, Poa pratensis, and brown-top.
6199	12·75	2·33	2·26	0·037	0·073	1·45	1·06	0·49	0·023	4·87	30·4	71·0	18·8	7·2	6/10/28	1927, super and slag, plus 8 cwt. lime. 1928, 3 cwt. super	Waharoa Downs	Sterility moderate: rolling downs. Poa pratensis, cocksfoot, and rye-grass dominant. Virgin heath country.
6200	11·50	2·30	2·18	0·049	0·113	1·21	1·24	0·53	0·035	4·63	28·9	69·7	25·2	5·1	6/10/28	Manured annually, 3 cwt. super. 1926, 4 cwt. lime. October, 1928, 3 cwt. super	Waharoa Downs	No sterility. Low, flat country. Good short feed. Rye-grass dominant. Down six years.

Samples collected by R. E. R. Grimmett and analysed by I. J. Cunningham.

Table 4.—Analyses of Pasture Samples from Poverty Bay Back-country (Malnutrition).

The figures are percentages on the moisture-free sample.

Lab. No.	Ash.	Crude Silica (SiO_2).	Pure Silica (SiO_2).	Ferric Oxide (Fe_2O_3).	Alumina (Al_2O_3).	Phosphoric Acid (P_2O_5).	Calcic Oxide (CaO).	Magnesic Oxide (MgO).	Manganese Oxide (Mn_3O_4).	Chlorine.	Nitrogen.	Proteins.	Grasses.	Legumes.	Weeds.	Date collected.	Manurial Treatment.	Remarks.
6215	11·96	1·87	..	0·050	0·157	1·13	1·87	..	0·006	0·82	4·72	29·5	43·6	49·4	7·0	23/10/28	..	Medium growth; weedy pasture; alluvial flats. *No deficiency disease.*
6216	11·00	3·93	3·76	0·022	0·092	0·85	1·20	..	0·025	0·79	3·44	21·5	71·2	24·3	4·5	25/10/28	Unmanured ..	Old pasture; deep pumice soil on terrace above papa slopes. *Hairlessness in calves* (not hereditary). Iodine deficiency suggested (sample showed 58γ iodine per 100 grammes dry matter; below average in iodine content).
6217	10·97	2·71	2·63	0·017	0·034	0·93	0·68	0·48	0·019	0·94	4·91	30·7	89·3	8·8	1·9	26/10/28	Not top-dressed	Cocksfoot and fog dominant. New bush-burn, seven years old. Best country on the place. Sick sheep recovered on here.
6218	10·28	3·10	3·03	0·017	0·022	0·81	0·74	0·45	0·024	1·18	3·71	23·2	91·1	2·0	3·9	26/10/28	„	Bush burned twelve to fourteen years ago; pasture beginning to run out. Cocksfoot, fog, and rye-grass dominant. *No sickness yet*, but sheep do not recover quickly here.
6219	9·92	3·98	3·86	0·016	0·067	0·66	0·75	0·38	0·018	0·85	3·27	20·4	91·9	2·0	3·1	28/10/28	Unmanured ..	*Most sick paddock on the farm.* Well watered with streams and gullies, but these are full of second growth scrub, rushes, piripiri, &c. Cocksfoot dominant, white clover plentiful, and piripiri common.
6220	9·06	2·94	2·84	0·015	0·089	0·67	0·77	0·41	0·032	0·85	3·54	22·1	94·4	4·1	1·4	28/10/28	„ ..	Felled and grassed eighteen years. English grasses nearly all replaced by Chewings fescue. *Very sick for sheep.* Lower gentle slopes and flats near river deeply covered by pumice; swamps and creeks filled with rushes, &c.
6221	12·83	1·36	1·25	0·018	0·045	1·04	0·87	0·51	0·032	0·97	4·15	25·9	94·7	3·4	1·8	28/10/28	„ ..	From faces and slopes, pumice-covered, outcrops of sandstone. Fog, creeping fog, and Chewings fescue dominant in that order. *Very healthy paddock;* originally southern-beech forest.
6222	11·80	3·57	3·46	0·018	0·064	0·92	1·06	..	0·028	1·08	3·80	23·8	87·8	7·6	4·6	28/10/28	„ ..	*Possibly sick.* Down twenty years. Cocksfoot, rye-grass, and fog dominant. Originally rimu-tawa forest.

Samples collected by R. E. R. Grimmett and analysed by P. H. Sykes, Iodine determination by Miss Simpson.

(To be continued).

PACKING OF BUTTER FOR EXPORT.

G. M. VALENTINE, Dairy Factory Superintendent, Massey Agricultural College, Palmerston North.

THE packing of a box of butter would seem to be a very simple operation, but the number of complaints received from overseas buyers indicate that there is room for much improvement in the work.

A considerable proportion of the butter exported is cut into pats with wire cutters by the retailer, and unless the block when turned out is square at the corners and free from pockets much recutting is necessary, for which the conveniences are not always available. Butter which comes in contact with the parchment usually has a slight woody or stored flavour, and may be a shade different in colour in comparison with the inside of the block; consequently it is a great advantage to be able to cut fifty-six pats from a box without waste. This can be done with wires which cut four layers of 14 lb. each, and only check-weighing is then required. This may appear to be a small matter to the person packing the butter, but it is quite important to the one who has to deal with it at the other end.

For the same reason the exact standard-sized box should be used by all factories. It must be apparent that a machine which is made to cut a block of butter 15⅛ in. by 10¼ in. by 11¼ in. will not cut one 14¼ in. by 10½ in. by 11¼ in. without much waste. A certain amount of inconvenience also arises at this end of the trade in machine packing where the boxes are not uniform in size. A case has been known where a factory had three makers' boxes in use, and all of them different sizes. When the shooks get mixed in such an instance the confusion can be imagined. Surely this is a matter where absolute standardization is called for.

PAPERING THE BOX.

Good packing starts with the papering of the box. Unless the paper is correctly creased and tucked into the corners the block of butter when turned out will have rounded corners. Carelessly placed end papers, for instance, will either cause a rounded end corner or the paper must break when the pressure of the machine comes on to it. The first piece of butter put into the box binds the two overlapped end papers. As the pressure comes on, the butter squeezes hard against the ends, thus locking the paper in two places. The result is as stated —a rounded end corner or a broken paper.

The aims in dressing a butter-box are to have a double thickness of paper covering the butter at every point; to have no surplus paper at any part of the box; to have an overlap at every joint; to have a neat attractive appearance when the box is opened up and the butter turned out; to have a dressing which will allow of the butter being inspected by the grader or buyer, either at top or bottom, without lifting more than one piece of paper; and, finally, to have a block of butter which, when stripped, will have square corners and be free from pockets.

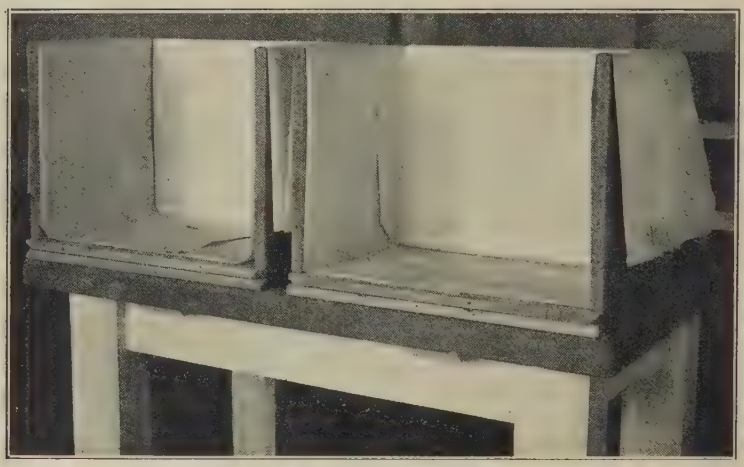

FIG. 1. TWO METHODS OF PAPERING A BUTTER-BOX.

(*a*) On left: The cross-over method. Note the rounded corners and uncovered wood on back corner at weakest part of box.

(*b*) On right: The envelope method. Square corners; no tucking required; no exposed wood.

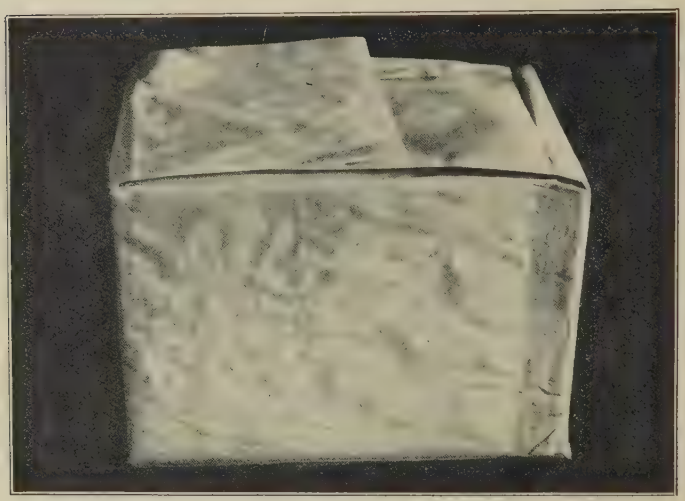

FIG. 2. BLOCK TURNED OUT OF BOX BADLY DRESSED BY CROSS-OVER METHOD.
Note single parchment at corners, and loose ends, giving an untidy appearance.

The Cross-Over Method (Fig. 1a).

Taking 20 in. by 30 in. as the standard sheet of parchment, and remembering that the standard box is $15\frac{1}{8}$ in. long by $10\frac{1}{4}$ in. to $10\frac{5}{8}$ in. wide and $11\frac{1}{4}$ in. deep, inside measurements, it will be seen that a plain fold and cross-over method of dressing does not allow sufficient paper to completely cover the butter. It can be accepted that there is only one way to fold the end papers, and that gives a double sheet 30 in. long by 10 in. wide. One can also agree that it is the best practice to put these sheets in first. To allow a lap of 2 in. in the bottom, crease the end papers by folding at $9\frac{1}{2}$ in. from one end. A number of sheets can be folded at one time, and if a block of wood is used to impress the crease it will be found that the paper sits closely into the corners of the box. If this is not done a rounded corner will result, as previously explained, especially with machine packing, where the papers are prevented by the clamps from slipping down. When folded over on the top of the butter it will be found that there is about the same amount of lap there.

The paper being now folded the opposite way gives a double sheet 20 in. by 15 in., which, if placed in the side in the same manner as the end, cannot possibly be made to completely cover the butter at the corners and provide a lap, as shown in Fig. 1*a*. At tops and bottoms, however, there will be an unnecessary lap of over 4 in., giving four thicknesses of parchment over nearly the whole of the butter. To overcome the lack of lap in the corners it is a practice to fold short, thereby getting a sheet 20 in. by 16 in., which gives a short lap in the corner. Since 2 in. of a sheet folded in this manner must be single, it follows that a portion of the butter in two corners must be covered with only one thickness of paper (Fig 2.) When the box is opened up these two methods give a most untidy package, and at least two sheets must be lifted in order to examine the butter. The only thing that can be said in favour of the cross-over method is that it is quick.

The Envelope Method.

By placing the 20 in. by 15 in. sheet in the box in the opposite way over 2 in. of lap can be obtained in the corners, $\frac{3}{4}$ in. in the bottoms, and 3 in. at the top. (Fig. 1*b*.) There are many variations of this method, but it is undoubtedly superior to the cross-over method, however it may be done. Probably the most common practice is to fold over the corners at the top of the sheet and tuck the bottom corners. Neat tucking is seldom seen, however, and the result is an untidy bunch of crumpled paper, which is very unsightly when turned out. To save the time in folding the corners, and the necessity for tucking, it is better to cut both these corners off; and if the sheet is folded unevenly in the first place, as shown in Fig. 3, there will be more lap available at the bottom and sufficient at the top for the packing-machine clamps to grip. The short side of the folded sheet is placed against the butter in this case. The longer side will then overlap it, and also adhere to the butter, leaving no loose ends (Fig. 4).

Boxes dressed in this way will conform to the requirements previously stated, and when the butter is turned out the whole of the paper will be adhering to it, and present no difficulty if the box has to be put back on to the block of butter, as there will be no loose ends.

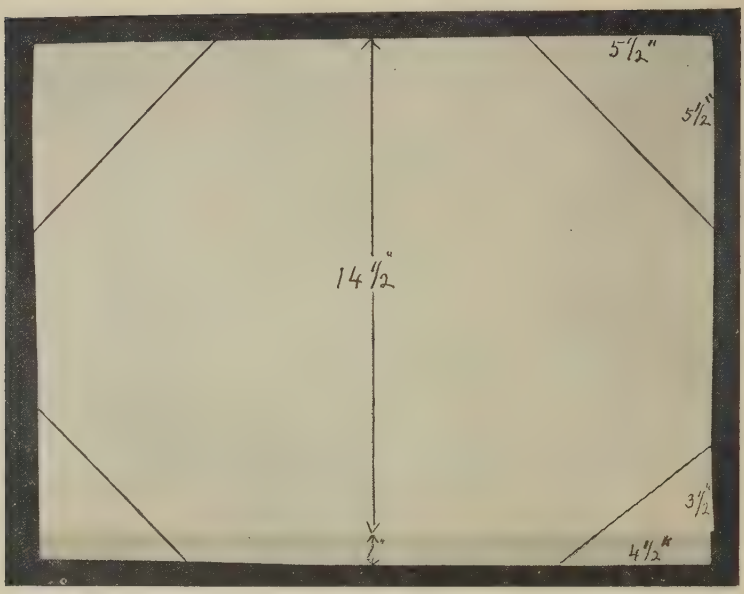

FIG. 3. SHOWING ARRANGEMENT OF PAPER FOR ENVELOPE METHOD.
Side papers folded short. Corners to be cut off on lines drawn in diagram.

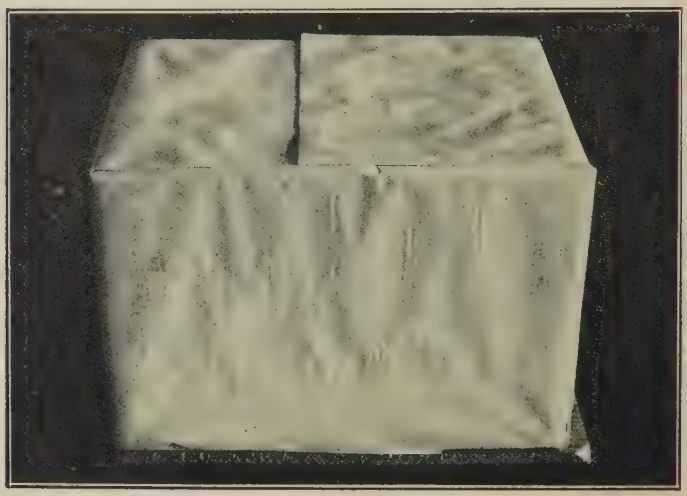

FIG. 4. BLOCK TURNED OUT OF BOX WELL DRESSED BY ENVELOPE METHOD.
Note double parchment over all surfaces, and no loose ends.

The measurements may require to be adjusted to suit boxes of a certain size. The cutting of such an amount of parchment entails much waste, but this is justified by the time saved and the neat result attained. Too much paper always makes a poorer parcel than just enough, and there is no reason why parchment for butter-packing should not be cut by the makers into the shape required, and so save the labour of all folding. The cube box was dressed with a 12 in. by 48 in. sheet, and if double parchment was required one sheet was put round the four sides on its edge and no cutting or folding was required.

The best method to follow if cutting the sheets in this manner is to make a wooden gauge the size of the folded sheets. Stack the sheets on a bench and place the gauge on top, then cut off the corners with a sharp knife, or with a hammer and a broad sharp chisel.

Finished boxes dressed by the two methods described are shown in Figs. 5 and 6.

One of the earliest methods of dressing butter-boxes was to have envelopes made which just fitted the box and from the packer's point of view they were very satisfactory. The drawbacks were the expense and the difficulty of finding a paste that would not develop mould. It was also found that two thicknesses of parchment gave better results. Should the packing-machines now on the market—which mould the block of butter in the same way as a pounder shapes pats—be successful, these envelopes may again come into use.

It may be remarked here that the general care of parchment in factories leaves room for a good deal of improvement, and should receive more attention, even if only as a safeguard against butter-moulds. The cover should be left on the opened ream while it is being used, and if mould trouble occurs the parchment should be soaked in brine-formalin solution.

WEIGHING.

Butter which has been churned at a low temperature and has been lying on a table long enough to set presents no little difficulty in cutting it into pieces of convenient size for packing. Much labour can be saved by cutting with a wire across the rolls in lengths to suit the box. This can be done either on the table or by laying the wires across the unloading-truck before it is run into the churn. The old method of weighing the empty box, filling it with butter, and then reweighing is now seldom seen. Experience has shown that more accurate weights are obtained by weighing the butter before packing.

A careful man at the scales is a valuable employee, and the check weighings from some factories would be a revelation to others not so fortunate. Although scales of a very old type which have seen over twenty years' service are in use to-day in some factories, no fault can be found with their weights.

Provided two correct 56 lb. weights are available, or even one in some cases, any scale can be adjusted to weigh off 56 lb. of any commodity correctly, even if they are incorrect at other weights. Having adjusted the scale, it is then only a matter of care to keep the weights right. Admitting that the amount at stake warrants the provision of the best of appliances, expensive appliances do not ensure correct work unless care is taken in using them. The man doing the work counts for more than an elaborate scale.

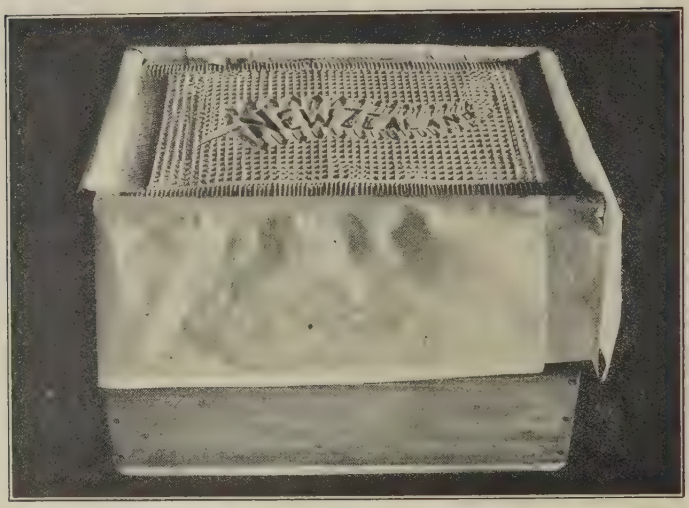

FIG. 5. BADLY-DRESSED BOX (CROSS-OVER METHOD), SHOWING A POOR FINISH.

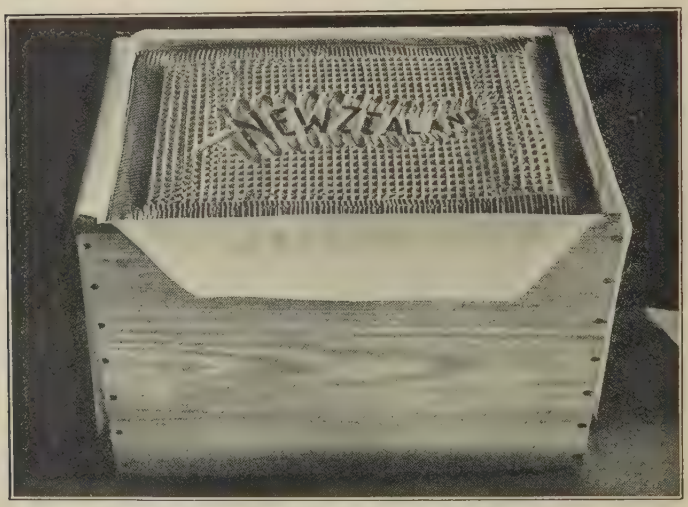

FIG. 6. WELL-FINISHED BOX, CORRECTLY PAPERED BY THE ENVELOPE METHOD.

Many mistakes in weighing are the result of butter sticking to the scale-platform. This can be avoided by covering the platform with a damp sheet of parchment.

PACKING THE BUTTER.

Where large numbers of boxes are being packed by hand — an unusual case nowadays—a solid bench with a clamp or wedges will save a lot of trouble and get over the very serious objection of putting the ends in first when hand-ramming, as it will hold the side papers in position and leave both hands free to handle the rammer.

The greatest mistake in packing, either by hand or machine, is putting too much butter into the box at a time. The misguided efforts of packers to put 56 lb. of butter into a box in one piece indicate that they have not a grasp of their work. The butter should be divided into at least three pieces, and be roughly moulded to the shape of the box. Ram carefully round the sides, especially the first piece, paying special attention to the corners. If the first piece is not rammed solid no amount of ramming of the second piece will make it so.

Machine packers have now come into almost general use, largely as the result of the firm body generally aimed at by New Zealand butter-manufacturers. They save a lot of hard work, and if used intelligently make a better job than average hand packing. As at present constructed they leave considerable room for improvement in their design.

The greatest weakness of the machines is the want of provision for easy adjustment of the thrust. Every one who has handled butter knows that, in common with other substances, its volume varies with its temperature. The packer should therefore be adjustable to allow of the thrust being set to suit the condition of the butter. Except in those factories which pack for city trade, where the pounding is done with wire cutters, the pressure on the machine is generally too light, and consequently pockets are left in the butter. Butter in the condition in which it is packed—that is, before it sets—has considerable elasticity and allows quite a margin for the pressure which may be exerted on it. As at present constructed the only way to increase the pressure is to remove the head and place a piece of board between the wood and the casting. If the wood is placed under the box it raises the latter too high, and the hoppers will be out of alignment and will not fit down into the box, while the head will jam as it comes down.

A little experimental work will show the pressure necessary to ensure good packing. A box-lid may be cut to fit the hopper, and placed on top of the butter in the hopper, after which the packer is set in motion. The butter is then turned out on to a table and shows whether it is well packed. If not, a thicker piece of wood may be tried.

As with hand packing, it is a mistake to put the butter into the hopper in one piece. It should be cut into at least three pieces, and care should be taken that the last piece is the largest and presents a smooth surface to the head of the packer. This will give a good finish requiring very little smoothing off by hand. Care should also be taken that all the butter belonging to the box goes into it.

The Benhil butter-moulder, at present used in the Waikato, introduces a new method. Its construction is similar to that of the pounding-machine by the same makers. In a box, the front portion of which is covered, there are two spindles. On the spindles are mounted two spiral flanges, one a right spiral and the other a left. The butter is placed in the open portion of the box, and the action of the flanges forces it out through the opening in the front of the box on to rollers, where it is cut off with wires in the same way as pound pats are cut. The rollers are then lowered to the level of a second section of rollers on the scales on to which the butter is conveyed. Here the weight is adjusted and the butter passed on to a third section of rollers, where the parchment, already suitably cut, is placed on the block of butter—the sides first and then the ends. The block is slightly smaller than the box, which is now slipped on to it, turned over, and finished in the usual way. The size of the block can be adjusted and the machine controlled in the same manner as a pounding-machine. Provided the butter is in proper condition, the block as turned out is square on the corners and free from pockets, and with ordinary care the weights should be correct.

FINISHING.

Assuming that the box is always opened at the top (which is not always the case, and therefore the bottom is equally important), the impression given by the appearance of the package when the lid is lifted will always be favourable or the reverse and have a bearing on the attitude of the buyer. A slovenly finish will incline the buyer to assume that the same carelessness has been displayed in manufacturing the butter and that the quality corresponds. Corners not filled, or an uneven surface on the butter, will indicate to him that the butter will not cut up well.

Having filled and rammed the box, smooth off with a trimmer, not with a pat, and roll with the National brand roller. Wipe the top edge of the box with a damp cloth to remove any pieces of butter, and fold over the side papers, then the end papers. By following this order an end paper may be lifted to examine the butter without disturbing the rest of the covering.

WEATHER AND WHEAT YIELD IN CANTERBURY.

SUMMARIZING in the *Journal of Science* a recent study of the relationship between the various meteorological factors and the wheat yield at Canterbury Agricultural College over a period of years, Dr. E. Kidson, Director of Meteorological Services, advances the following tentative conclusions:—

(1) The weather variations in winter are responsible for only very slight variations in the wheat yield; cool and dry conditions are probably favourable. (2) In spring and summer warm and moist conditions are favourable, especially in the growing-period, but considerable losses may be caused by heavy rain in February. (3) There seems to be little prospect of making a useful crop forecast any considerable time before harvest, since conditions in the period immediately preceding the cutting of the crop have the greatest influence on the yield.

LIVE-STOCK DISEASES ASSOCIATED WITH CALCIUM DEFICIENCY.

ROBERT B. H. MURRAY, M.R.C.V.S., D.V.S.M., Canterbury Agricultural College, Lincoln.

THE importance of calcium as an addition to the food of animals does not seem to have been fully appreciated in New Zealand, though there arrive periodically from outside sources reports that some disease or other is caused directly or indirectly by a calcium deficiency.

Since the feeding of calcium, either as lime or as bone-flour, is inexpensive (the cost of feeding a dairy cow 2 oz. per day, which amount has been found beneficial by Linton(1), for one week being just over 1d.), it is surely worthy of trial. In this manner for a very moderate outlay each farmer can experiment for himself, with the assurance that if no benefit be derived certainly no harm will ensue. From another point of view this could be commended, since the fodder on different farms and even on different paddocks varies in its calcium content.

Probably of the diseases claimed to be associated with a calcium deficiency milk-fever is of premier importance to the New Zealand farmer. Within recent years Dryerre and Greig(2) have found that cows suffering from this disease have a deficiency of calcium in their blood, probably due to the large amount of this substance in the collostrum or first milk. In support of this Sjollema(3) found that calcium chloride injected into the blood-circulation of a milk-fever patient gave a quick recovery. Moreover, Davidson(4) claims that by feeding minerals the number of cases of milk-fever in a herd of from eight hundred to one thousand cows in Hong Kong was markedly decreased.

While discussing milk-fever it is interesting to note that cases of paralysis in ewes, both before and after lambing, have been recorded by Young and Dalling(5), in Scotland and in the north of England, which responded readily to udder-inflation—that is the common treatment for milk-fever. In these records it is stated that such ewes almost invariably have twin lambs. Owing to the similarity of this condition with milk-fever in cows, and also with ante-partum and post-partum paralysis of ewes as recorded in New Zealand by Gilruth and Reid(6), it is not unreasonable to hope that a calcium addition to the diet might be beneficial to pregnant ewes.

To continue this reasoning it is not improbable that post-partum paralysis in cows (that is, the condition in which cows go down after calving and, although bright and apparently in good health, are unable to rise for a period of from one week to ten days) may also be laid at the door of a calcium deficiency.

Very recent investigations by Montgomerie, Savage, and Dodds, and by Harvey(7), into tetany in mares, a condition in which suckling mares suffer from nervousness, excitement, and twitching of muscles, show that the blood of the patients is deficient in calcium, and that udder-inflation brings about a rapid recovery.

A further nervous disease—namely, Australian stringhalt—has been associated by Corlette[8] with a calcium deficiency. In that article the scientist remarks on the similarity of the symptoms produced in fowls by feeding a ration of low calcium content to those of the Australian enzootic stringhalt in horses, which disease has been described in New Zealand by Reakes[9].

Among bone-diseases found in New Zealand, osteomalacia, osteoporosis, and rickets have been proved to be at least in part due to insufficient calcium in the diet.

Pica, or depraved appetite, is a digestive disturbance of cattle due to a deficiency of alkalines in the system, for the treatment of which a New Zealand authority, Reid[10], has recommended bone-meal. Sand-colic is regarded by Corlette[11] to be due to horses eating sand and earth in an endeavour to restore the calcium content of their blood. Observant farmers may have noticed cows licking earth and "bone-chewing" for the same reason. With regard to young lambs, I have personal experience of their licking earth and of their devouring lime with avidity. In this respect it is possible that access to lime may have a beneficial effect on the disease of lambs known as "pulpy kidney," since at post-mortem a certain amount of earth is practically invariably to be found in the stomach. The possibility of a continued bacterial infection of lambs' intestines from this source cannot be ignored.

It has also been claimed by Lindsay and Archibald[12] that cows fed on a calcium-deficient ration are difficult to get in calf; and by various American scientists[13] that abortion is apt to occur among them, that they often produce weak calves, and that their milk yield suffers. Experiments at the Rowett Institute[14] have shown that cows fed on a sufficient mineral diet enjoyed better health, bore heavier calves, and milked better than those on a mineral-deficient ration.

Apart from any question of disease, it has been shown that a heavy-milking cow gives out more calcium in her milk than she absorbs from her food, with the result that though on apparently excellent food she may become thinner and thinner as the period of milking proceeds, due to the fact that she is having to draw on her body supplies for her milk. With regard to growth, Ingle[15], experimenting upon rabbits, proved that there is less growth, both in flesh and in bone, when an animal is fed on a calcium-deficient ration than when on a proper ration.

The question of how to administer the required calcium now arises. The practical methods available would seem to be (*a*) top-dressing with lime or superphosphate, (*b*) giving lime in the food, (*c*) giving bone-flour in the food, (*d*) giving lime in licks, and (*e*) pellet feeding.

With regard to top-dressing, an Australian writer, Rose[16], advises the application of 1 cwt. of superphosphate per acre as a preventive of osteomalacia. Again, Godden[17], a Scottish authority, has proved that top-dressing with lime increases the calcium content of grass. The giving of lime or bone-flour in the food, though having the disadvantage of requiring the animals to be fed chaff or oats, has the advantage of ensuring that each animal gets its requirements. Of these two the

latter is to be preferred, and is best supplied as steamed bone-flour. The putting-out of licks with a high lime content would seem to be the most practical method of supplying to sheep and young stock. The pellet-feeding method, at present under trial by Aston[18], promises to be very useful, and has the decided advantage of supplying other mineral needs. Its application to big blocks of hill country, however, would entail a certain amount of extra labour.

In conclusion, it is not intended to claim for calcium as is claimed for many proprietary stock drenches -that it cures all ills, but merely to point out that all the above conditions have been associated with a calcium deficiency by various research workers. Many of the foregoing statements are still debatable, and since we do not yet understand the part played by disease of the parathyroid glands (the glands responsible for maintaining the level of the calcium content of the blood), the beneficial results of feeding calcium cannot be estimated. Nevertheless such evidence as we have is sufficient to warrant a greater use of bone-flour and lime in stock-feeding, and if the farmer fails to derive protection from disease for his stock he should at least find that his stock will be more robust and more productive.

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Control of Contagious Abortion in Cattle.—Mr. A. D. McEwen, of the Research Institute in Animal Pathology, London, who has just completed an extensive tour of the United States with special reference to contagious abortion, writes as follows: "There is no evidence to show that vaccine has any beneficial influence upon the disease once it is established. The disadvantages and limitations of vaccination have caused the great majority of research workers in America to abandon this method of combating the disease. The method which receives credit is the prevention of the spread of the disease by segregation of the infected animals."

Wheat Research Institute.—The laboratory of the Wheat Research Institute at Christchurch is now fully functioning, and tests upon samples of grain collected during the past two seasons are in progress. The data for the field experiments at Lincoln College also are being analysed in conjunction with the laboratory tests. The expenditure of the Institute in the past year was largely connected with the fitting-up and equipment of the laboratory, and the Institute now possesses a first-class laboratory capable of dealing with all chemical, physical, and milling problems which concern the wheatgrower, flour-miller, and baker.

MOULDS IN UNSALTED BUTTER.

RESEARCH AT WALLACEVILLE LABORATORY.

G. F. V. MORGAN, N.D.A., N.D.D., Dairy Division, Wallaceville Laboratory.

ONE of the most important factors in the spoilage of unsalted butter for our export trade is that of moulds. In many ways the mould problem is harder to deal with than the bacteriological contamination of butters, the reason being that, although the latter trouble is difficult to overcome, numbers of bacteria that may enter the butter through the process of manufacture are harmless and their effects are not even felt in the ultimate flavour of the finished product. The possibility of contamination of unsalted butters by moulds at all stages of manufacture is as great as that by bacteria, but the difference lies in the fact that each mould-spore which enters is likely to have an immediate effect on the finished product.

The number of species of moulds that are of interest to makers of unsalted butter and are common in butter-factories in New Zealand is not great, and from the results of experiments carried out at the Wallaceville Laboratory it has been shown that only three of the six common moulds that have been found present in New Zealand unsalted butters are capable of germinating in two weeks from the time of defrosting; the other three species are only capable of germination after three weeks from the time of defrosting after two to three months at cold-storage temperature, by which time the butter would probably be consumed.

The six species mentioned are all capable of immediate germination in butters, and can all germinate at a temperature of 12° to 13° C. in one week, causing immediate and visible effects. These species are all common in the factory atmosphere—in fact, most butter and cheese factories are probably impregnated with moulds. Large patches of moulds may often be seen growing on the concrete walls and wooden roofs of butter-rooms. A favourite part of the factory for mould growths is the woodwork surrounding the chilled water-tanks, and the walls and ceilings in the neighbourhood. From these positions the contamination spreads to all parts of the factory and affects everything that comes into contact with the butter. Factory water-supplies are often seriously contaminated.

The main source of mould contamination of unsalted butters is undoubtedly through atmospheric contamination of the cream in the freezing-vats after pasteurization, where the cream remains exposed to the air overnight. A mould and bacteriological survey has recently been made of various factory atmospheres by exposing petri dishes containing sterile glucose agar (of a rather higher percentage of glucose than that usually employed in bacteriological work) by the side of the cream-vats for the duration of time that the cream remained in them. On incubation at the laboratory the plates showed a very considerable mould count from the spores or seeds of the moulds that had fallen on their surface, several plates showing a count of seventy-six to eighty individual colonies. It might here be mentioned that these plates showed a representative number of the six common moulds already

FIG. 1. CROSS-SECTION OF BLOCK OF UNSALTED BUTTER, SHOWING BLACK-SPOT MOULD (STEMPHYLIA).

Note depth of mycelial growth, and development in open spots and fissures.

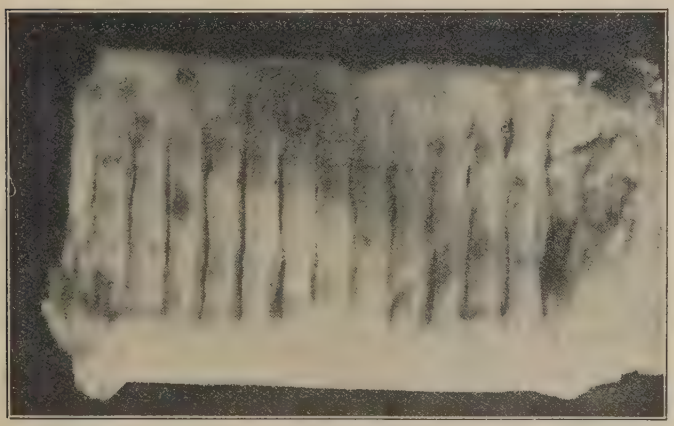


FIG. 2. OUTSIDE APPEARANCE OF BUTTER SHOWN IN FIG. 1.

[*Photos by G. F. V. Morgan.*

referred to, though the two moulds that were most common were *Cladosporium herbarum* and *Cladosporium butyri*. It is probable that if the media used had been capable of growing all the species of moulds whose spores were present in the factory air the mould count would have been very much higher. Moulds, however, do not grow equally

well on all media, and a glucose agar was chosen as one that grew the greatest number of different species. The disadvantage, however, of using glucose agar only lies in the fact that it will not grow well moulds of the *Stemphylium* type, which are among the most common present in the butter-factory, and give rise to the black spot in butter that is a very common fault.

Types of Moulds found present in Unsalted Butters.

The types of mould found present were as follows: *Penicillium glaucum, Stemphylium, Fusarium lactis, Oidium lactis, Cladosporium herbarum, Cladosporium butyri.*

Penicillium glaucum.—Among the above-mentioned moulds the most common is *Penicillium glaucum,* the spores of which are to be found practically everywhere. Apart from dairy-produce, this mould may be found growing on a variety of objects where the atmosphere is cool and humid. It is commonly found growing on stale bread, and on jam that has been allowed to remain open in a damp cupboard. *Penicillium glaucum* produces a blue-green growth consisting of clusters of aerial hyphæ and conidiophores, at the head of which are the conidia or seeds of the mould. The actual habitat of the *Penicillium* type of mould in the factory is hard to determine. In most factories comparatively little trace of the mould itself is found on the premises, but the exposure of petri dishes to factory atmosphere shows that the spores of this mould are present in considerable numbers. Butter-boxes and parchment that are allowed to get damp very soon develop growths of this mould; butter-salt occasionally contains its spores, and the power of the spores to germinate after remaining in dry salt for a considerable time seems to remain unhampered. Spores of the mould are also frequently found in the water used for washing the butter. Factory experience seems to point to the fact that the *Penicillium* type of mould is found to a greater extent in the drier part of a butter-factory, such as the butter-box store, than in the butter-room itself, where the atmosphere is more inclined to be warm and steamy.

Stemphylium.—As distinct from the *Penicillium* type, this mould is most frequently found in and about the butter-room and over the storage-tanks for chilled water. Patches may be seen growing on the concrete walls of the butter-room and round the receiving-stage, but the heaviest growth is usually found on the wooden ceilings of the butter-room. The probable reason for this is that the natural habitat for this mould is rotten wood, and it is, as a rule, not very long before the woodwork of the factory butter-room gets waterlogged by the steam that is continually rising from the pasteurizers and acquires a more or less decayed condition. When this happens moulds of the *Stemphylium* type make their appearance. From the woodwork of the ceilings the mould spreads to the concrete walls of the factory, which absorb moisture fairly readily and are nearly always in a damp condition. The appearance of this mould is quite characteristic in so far that it produces a much finer aerial growth than moulds of the *Penicillium* type, though the conidia themselves are shorter. The mould produces characteristic dark-brown or black patches somewhat resembling soot.

Fusarium lactis.—This mould is responsible for the red spot found in unsalted butters. Apart from the red discoloration caused by the mould, a similar pigmentation may also frequently be caused by a *Torula* producing a red colony on artificial media. This *Torula*, however, is a very slow worker at low temperatures and does not grow well in butter, though it may grow luxuriantly on damp butter-parchment or on damp butter-box wood, where it produces numbers of bright-red spots. It is also capable of developing a red pigment in cream and milk, but only after a considerable time has elapsed following inoculation. *Fusarium lactis* is the most delicate of all the common butter-moulds. It suffers most from long-continued cold-storage temperatures, though it will germinate in less than a week at a temperature not lower than 10° C. The red discoloration in unsalted butter is very marked when present, but is most frequently found in unsalted butters used for local consumption, and not in the butters after arrival in Europe. The spores of this mould are common in all factory atmospheres, and may frequently be found present in factory water-supplies.

Oidium lactis.—This is perhaps the most common mould associated with dairying. It is most frequently seen on the crusts of soft cheese, particularly Coulomier and Pont l'Evêque, but is a common development on all dairy-produce. This mould develops a tangled mass of aerial mycelium, giving a white felted appearance to the medium in which it may be growing. Apart from the white patches on the surface of butter, it does not seem to produce any discoloration in the body of the article itself (a slightly brown discoloration has sometimes been noticed in very old cultures of this mould in butter), but its presence gives the butter a distinct flavour similar to that imparted by certain types of yeasts, and typical of the types of soft cheese already mentioned. The flavour can be recognized sometimes long before the white surface growth is visible. This mould is so common in dairying that dairy-produce may also be considered its natural habitat, but is not of very great importance in the manufacture of butter for export. It is, however, one of those moulds that will resist cold-storage temperature for three months and germinate in less than two weeks after defrosting. Spores of this mould are nearly always present in both salted and unsalted butters, but frequently die out without germinating. Periodical examination of unsalted butters have shown that the mould is present in a virile condition for about six weeks after manufacture, and that the spores are capable of germination for about this length of time when the butter is held at room temperature, though the mould rarely becomes visible on the outside of the butter and can only be demonstrated when cultures are made on artificial media suitable for its growth. After six weeks the mould gradually dies out. The spores of *Oidium lactis*, though they will not germinate in salt above 4 per cent., will germinate on transfer to a suitable medium containing less than that percentage.

Cladosporium herbarum.—This mould produces characteristic olive-brown patches in unsalted butter. As the butter containing the mould matures, the olive or dark-brown patches change to black. A characteristic feature of both *Cladosporium herbarum* and moulds of the *Stemphylium* type is that they do not appear to produce any considerable growth of aerial mycelium or conidiophores in butter, and

usually the only visible sign of their presence is the discoloration that they produce. In the case of *Oidium lactis* and *Fusarium lactis*, however, a thick felted mass of aerial mycelium is produced in unwrapped butter-samples containing these moulds. *Penicillium glaucum* also produces thick tufts of conidiophores terminating in typical bushy green heads. The spores of *Cladosporium herbarum* are common in all parts of a butter-factory, but are found most frequently on petri-dish exposures taken in the butter-room and damper parts of the building.

Cladosporium butyri.—This mould is in many ways similar to *Cladosporium herbarum*. The important point of difference is that *Cladosporium butyri* commences its development with a white growth which gradually changes to a dark olive in the centre and then to a very dark olive and black. Cultures of this mould in cream and butter show a dark-olive background in the early stages of development, and a thick growth of tangled white mycelium over the surface, giving the mould two distinct shades of colour simultaneously. This mould is not nearly so common as *Cladosporium herbarum*; nevertheless it frequently occurs in unsalted butter.

Cultural Methods and Technique in Examination of Unsalted Butters.

In the research work carried out at Wallaceville Laboratory the cultural characteristics of the various moulds were not considered to any great extent, as it was realized that cultural characteristics of moulds differ considerably according to temperature of incubation, and acidities, humidity, and composition of the media in which the mould spores may be cultured. Sources of contamination and the structure of various moulds were studied closely, as was also their power to resist low or high temperatures, and the action of brine solutions and formalin on their spores. For cultural purposes three types of media only were used throughout the experiments conducted. The work included the examination of more than two hundred samples of butter from various factories in the North and South Islands of New Zealand, many of the butters having been made for show purposes.

In the examination of these unsalted butters the samples were taken under sterile conditions, and allowed to remain at room-temperature for a sufficient length of time for the moulds to make their appearance on the surface of the butter. In the two hundred samples examined containing moulds by transfer to artificial media on which the growth was more luxuriant and easier to study, only the six moulds already listed were found, with the exception of one sample that was found to contain *Aspergillus fumigatus* instead of *Penicillium glaucum*, and another that contained *Fusarium elegans* instead of *Fusarium lactis*. The former of these two moulds is common in cheese but uncommon in butter. It is not clear why this should be the case, as *Oidium lactis* and *Penicillium glaucum* are common in both, and *Stemphylium* appears fairly frequently on the tops and bottoms of cheese as a black dust. The two artificial media that were found most useful for pure culture work were Czapek's media for *Aspergilli* and malt agar. In both cases the media used were of normal pH. The composition of the media is as follows:—

Czapek's agar (for Aspergilli).

Distilled water	1,000 c.c.
Sodium nitrate	3 grammes.
Potassium phos.	1 gramme.
Magnesium sulph.	0·5 gramme.
Potassium chloride	0·5 gramme.
Ferrous sulphate	0·01 gramme.
Sucrose	30 grammes.
Agar	50 grammes.

Malt Agar.

Distilled water	1,000 c.c.
Malt	50 grammes.
Agar	30 grammes.

The effects on unsalted butter of each of the individual moulds described were studied by using sterile cream, inoculating it with spores of the mould required to be grown, and churning the cream in the flask in which it was sterilized and inoculated. In these cases no effort was made to accomplish a thorough working of the butter, as the possibility of contamination appeared too great. In all cases where pure culture transfers were made of mould-spores from one medium to another, control or check plates of casein agar or nutritive glucose agar were also similarly treated, as neither of the media previously mentioned is suitable for bacterial development. Casein agar is particularly suitable for bacterial but not yeast development.

Cultural and Structural Characteristics and Differences in Development of Moulds in Unsalted Butter.

STEMPHYLIUM.

Contamination.—This mainly occurs through the growth of the mould on the woodwork and damp concrete walls of butter-factories; most commonly found on the woodwork round the cool water-tanks. Dark sooty patches typical of the development of this mould may be seen on almost any damp concrete in or around the butter-room. The mould is capable of growing through paint if it happens that it has already obtained a foothold before the wood or concrete was painted, and this applies particularly to paints which contain an excess of terebine. Spores from the growths already described ultimately become detached, circulate in the factory atmosphere, and settle in the cream while it is in the freezing-vats.

Spore-formation.—Spores are numerous, and grow at the termination of very short hyphal cells. Their growth is not confined to aerial development, but also takes place in the body of the medium in which it may be growing, particularly in loose-textured butter, producing a concentration of dark colour where this occurs. The spores are multicellular and of varying size and shape; most of them show a regular egg-shaped growth containing seven or eight cells, each of which is capable of individual germination, though when their germination is watched in a suitable liquid medium under the $\frac{1}{6}$ lens of the microscope only one cell per spore appears to germinate. Cells of these spores may be very irregular in shape, and may contain as many as ten cells visible under the microscope. The spores are usually dark brown to black in colour.

Mycelial Growth.—In artificial media and butter this mould produces a dense reticulated mass of short hyphal cells forming the mycelium,

which stains readily. Spores are produced in clusters at irregular intervals over the surface and in the body of the medium in which it may be growing. Pigmentation occurs in the cells of the mycelium, but it is not diffused to any extent into the body of the butter. Mycelial cells appear smooth and regular in shape, unlike the roughened cells of the *Aspergilli* and a number of other moulds. Mycelial growth as a rule only extends ½ in. into the body of the butter—usually less, unless it follows a fissure in the texture. Growth of aerial hyphæ is usually very short though dense, and resembles patches of black dust rather than colonies of moulds. The spores of the mould are capable of germinating on the surface of butter-paper, and the mycelia of growing into and through the butter-paper into the body of the butter itself.

The thermal death-point of mould-spores is difficult to determine, more particularly in liquids which are of interest to the dairyman, as their resistance to surface tension causes most of the spores to float on the surface of the medium. A number of experiments on the thermal death-point of spores have been carried out at Wallaceville, but great irregularity has always attended the results. In the series of plate cultures, on the surface of Czapek's mould medium, *Stemphylium* spores have germinated irregularly after heating in water, milk, and cream from 50° to 70° C. Germination has never occurred at a temperature higher than 70° C.

Resistance of moulds to brine solution is fairly great. Moulds of the *Stemphylium* type are capable of germinating and growing well in media containing 6 to 7 per cent. of salt, and the spores of this mould will germinate after remaining in a saturated solution of salt for fifteen minutes.

Resistance to Formalin. Spraying or painting with weak solutions of formalin is quite useless to prevent or check the growth of moulds. Mould-spores will germinate after remaining in 4 per cent. formalin for ten minutes. The use of disinfectants for reducing mould-development in factories has in most cases been found unsatisfactory. The most useful chemical for the destruction of moulds is mercuric chloride, and this, owing to its highly toxic properties, should on no account be used in or about a factory. Formalin or chloride of lime may be used in the factory, but are generally used in far too weak solutions, and if used in strong solutions their effect is fully felt for far too short a period for them to be really effective. It has been found that even when substances that have been treated with strong solutions of formalin are allowed to stand at a suitable temperature and humidity for a week the mould so treated has again appeared. Spores of *Stemphylium* are capable of remaining virile in water for more than four months, and may therefore form a lasting contamination of factory water-storage tanks.

Biochemical Action and Effect on Dairy-produce.—The effect of bacteria-free cultures of *Stemphylium* mould on dairy-produce has been watched during the course of work on butter-moulds at Wallaceville. Further and more complete work on the chemical changes produced is shortly to be undertaken. Cultures grown from spores apparently free from bacteria in so far that check cultures carried out on casein agar showed no bacterial growth showed that this mould was rapidly

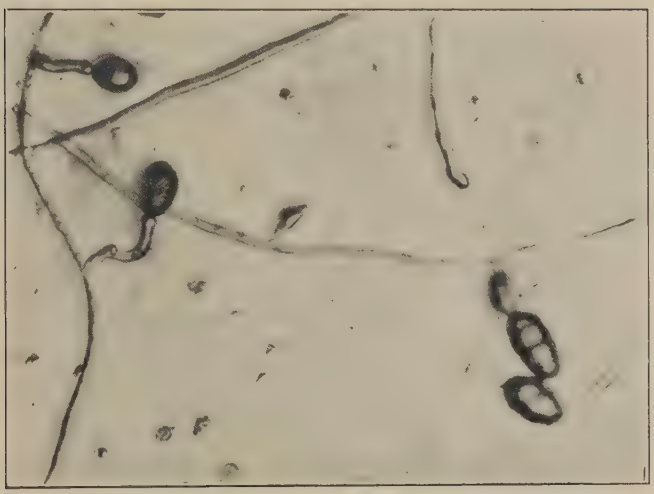


FIG. 3. PHOTOMICROGRAPH SHOWING MYCELIAL GROWTH AND HEAD FORMATION TYPICAL OF STEMPHYLIA MOULD. ($\frac{1}{12}$ LENS.)

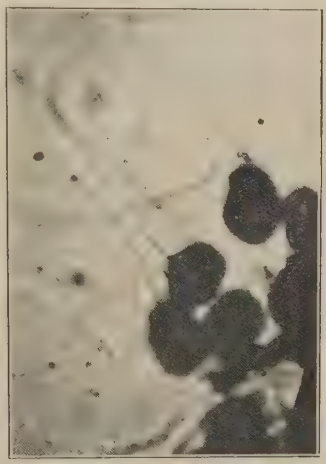


FIG. 4 (LEFT). PHOTOMICROGRAPH OF SPORES OF STEMPHYLIA, HIGHLY MAGNIFIED.

FIG. 5 (RIGHT). PHOTOMICROGRAPH SHOWING GERMINATION OF MULTICELLULAR SPORES OF STEMPHYLIA.

[Photos by G. F. V. Morgan.

proteolytic, with the production of an alkaline condition in artificial media, cream, and milk, probably due to the production of ammonia in the breakdown of the protein. Marked gas-formation was noticed, but no fermentation of lactose, though there can be little doubt that sugars generally, as well as lactose, can be used by this mould in the development of its tissue. It is capable of growth in water in which a weak solution of lactose has been added, and, though the spores can remain virile in water for more than four months, they are incapable of germination and development of mycelial growths in water alone. There is little doubt that once the mould has been established in butter it has a very definite effect on the butterfat, but after a number of experiments moulds could not be induced to grow in butterfat from which casein, sugar, and moisture had been removed, nor would they grow in butterfat and lactose.

Anaerobic Growth.—Experiments have recently been carried out at Wallaceville on the power of butter-moulds to germinate anaerobically. Plate and butter cultures were sown with the spores of the *Stemphylium* mould and placed in a McIntosh and Fildes anaerobic jar. The experiment was carefully carried out; control tubes of methylene blue, glucose, and caustic soda were used as indicators, and complete anaerobiosis was obtained. The results of several series of growths were considerably varied. A number of plates showed no growth at room-temperature in ten days; other plates showed a slight growth at one week. However, several strong growths were obtained. In all cases the indicator remained colourless after the flask had been closed and the electric current cut off. All the six butter-moulds listed will grow well under partial anaerobic conditions. Incubation was carried out at 20° C.

Behaviour under Cold-storage Conditions.—Several samples of sterile cream have been inoculated with spores of the *Stemphylium* mould, and subsequently churned by shaking in the flasks in which the cream was sterilized. The buttermilk was then removed with a sterile siphon and the unworked butter divided into two portions, one of which was incubated at a temperature of from 10° to 12° C.; the other, after transfer to a sterile flask, was placed in cold storage varying in temperature from 3° to 5° C. The butter cultures incubated at 10° C. germinated in one week; those placed in cold storage showed no sign of growth in three months. On removal from cold storage, and after defrosting, the *Stemphylium* mould grew well after two weeks at room-temperature.

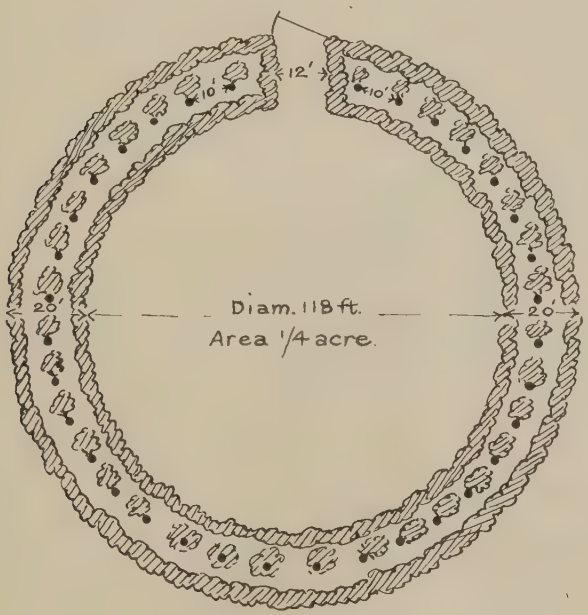
(To be continued.)

Cleaning of Dairy Pipe-lines.—In a recent report Mr. W. Dempster, Dairy Instructor, Hamilton, mentions that at the Waitoa and Waharoa skim-milk-powder factories the cream is conveyed to the butter-factories, some chains distant, by pipe-lines which were erected some years ago and are still in good order and have never given any trouble. The pipe-line is cleaned by first pumping through it warm water (about 130° F.), followed by a soda solution (about 160°). There is a steam connection into the pipe (so that the steam travels back towards the pump and the pump is also steamed) where a spring valve releases the steam when the pressure reaches 7 lb., and, after the soda washing, the steam is blown through for half an hour.

A SHELTER-RING FOR STOCK.

(Extract from State Forest Circular No. 25, "Farm Shelter.")

WHERE close shelter is required for a limited number of animals, such as a herd of cows or a mob of newly shorn sheep, the idea presented in the accompanying diagram should prove to be of practical use.



(As an alternative a square formation may be used.)

A dry hillock should be selected, or, if such is not available, the highest part of the paddock. First set out a circle enclosing sufficient space to accommodate the stock to be sheltered, then erect two fences round the circle 20 ft. apart, with gateway facing north. Before closing the fences, plough and cultivate the area to be planted. Midway between the fences, plant a row of conifers (species according to soil and climate), and against each fence a hedge of barberry, elæagnus, or boxthorn, &c. (also according to soil and climatic conditions). Once established, this shelter-ring should require only an occasional examination during the planting season to replace any failures.

CITRUS FRUITGROWING IN NEW ZEALAND.

Lecturette by P. EVERETT, Orchard Instructor, Thames and Bay of Plenty district, broadcast from Radio Station 2YA, Wellington, July, 1929.

IT should first be explained that the name "citrus" is a generic name for a number of plants, and includes lemons, oranges, limes, citrons, grapefruits, mandarins, and shaddocks. All these fruits are to be found growing in New Zealand to a greater or lesser extent.

Most of the citrus family are natives of India and other warm parts of Asia; consequently the colder parts of this country are not generally suitable for their growth. The best localities for their culture are in the east coast region of the Auckland Province. In the year 1928 the area in orange and lemon trees in Auckland was 875 acres, as compared with 160 acres for all other parts of New Zealand combined. During the four-year period from 1924 to 1928 the area in these fruits increased by 139 acres in the Auckland Province, whereas the increase for all other districts was only 12 acres.

Regarding the quantity of these fruits produced in New Zealand, it is estimated that during the year ended 31st March last the production for the Tauranga district alone was approximately 15,000 bushel cases of lemons and 1,500 bushel cases of oranges. When it is borne in mind that there are comparatively few citrus-orchards in New Zealand yet in full bearing, and that probably more than one-half of the orchards have not yet commenced to bear fruit, it will be seen that this young industry already counts for something. Further, the increased area being planted annually goes to show that considerable progress is being made in the culture of these fruits.

Persons contemplating the planting of citrus fruit-trees for commercial purposes would be well advised to go very thoroughly into the matter of suitable varieties and stocks, for varieties that have proved suitable for commercial planting in some parts may not give satisfaction in other parts. Information on these matters can always be obtained from the district Orchard Instructor, or from the Director of the Horticulture Division, Department of Agriculture, Wellington.

For those wishing to grow a few trees for domestic purposes I would suggest the following varieties as being suitable:—

Lemons: Lisbon, Genoa, and Eureka. For the colder parts of New Zealand the Meyer lemon is claimed to be most suitable, but it is not generally recommended for commercial planting at the present time.

Oranges: Ruby, Washington Navel, and Navalencia. For marmalade the Poorman orange is the best. There are probably more Poorman orange-trees grown in New Zealand than all other varieties together, and their fruit is rapidly coming into favour for dessert use.

Other citrus fruits, such as grapefruits, limes, mandarins, citrons, and shaddocks, will all thrive well in warm and sheltered locations in the North Island, and bear good crops of fruit. Citrus-trees, being

evergreen, are often grown on lawns for ornamental purposes. For fruit-production, however, it is most important that they be planted in well-drained soil and in a sheltered location.

Brief reference will now be made to the diseases and insect pests that are troublesome in citrus-orchards. Citrus-trees do not require nearly the same amount of attention as do most other fruit-trees. For instance, apple-trees are often sprayed as many as nine times a year, whereas citrus-trees seldom require more than three sprayings annually, and in many orchards one spraying is all that is necessary. The three most serious troubles citrus-growers in New Zealand have to contend with in their orchards are citrus brown-rot, red scale, and verrucosis. In many orchards that have been well cared for from the time of planting neither red scale nor verrucosis has yet made its appearance.

Brown-rot has been present in parts of Auckland Province for many years, but was not general throughout citrus orchards in this district until the winter of 1927. During that winter extensive damage was done in a great many orchards, not through the disease being difficult to control but because growers were caught unprepared. In most parts of New Zealand all that is necessary to keep citrus-trees free from brown rot is to spray before the disease makes its appearance each winter with bordeaux mixture, at a strength of 4–4–40. In certain clay soils it has been found necessary to supplement this treatment by applying sulphate of iron to the soil under the trees, and by cutting away all limbs growing near the ground.

Verrucosis, which causes grey-coloured scabs and protuberances on lemons, can be kept in control by applying one bordeaux spray annually during the month of November. Where trees are severely infected, three sprayings should be applied each year until the disease is got under control.

Red scale is more difficult to control than either of the other two diseases mentioned. To combat this insect spraying-oil should be applied. Reasonable control can be effected by spraying once annually, the most effective time being either the last week in February or the first week in March, according to the seasonal conditions. To make certain that every portion of the tree is coated with the spray it is necessary to first see that the tree is reasonably open. In cases of severe infestation two sprayings annually are advisable, the first early in February and the second towards the end of March. This treatment suggested for the control of red scale is equally effective for other scale insects and citrus red-mite that are at times troublesome on citrus-trees.

Now for a few remarks to consumers of citrus fruits, which includes almost everybody. For many years past there has been a certain amount of prejudice against lemons and oranges grown in our own country, brought about by the false impression that the locally grown fruit was invariably inferior to the imported article, and that the keeping-quality was also inferior. This prejudice happily is now disappearing as a result of the more up-to-date methods of handling the fruit now being practised by our growers.

It is held that for all ordinary uses the first-grade locally grown lemons are equal in quality to the best imported lemons. Regarding oranges grown in New Zealand, in many cases this fruit is not equal to the imported article that has been grown in a warmer climate. However, varieties suitable to our climate, and grown under favourable conditions, will produce fruit that leaves little to be desired.

The main reason why the prejudice referred to has existed may be said to be that until very recent years most of our lemon-growers marketed their fruit individually, practised crude methods in handling their crop, and adopted no measures for the prevention of decay. For instance, lemons were very often forcibly pulled off the trees, and this frequently damaged the base of the fruit. In other cases the fruit was allowed to drop on to hard ground and become bruised. It was then gathered and roughly tipped into cases, and straightway despatched to market. Again, the trees were stripped of all coloured fruit about every third month, which resulted in many lemons being oversize and having a thick rind. Lemons handled in a rough manner can seldom be kept long before decay sets in, and when the fruits are lying packed in cases the rot rapidly spreads from one to another, so that in a few weeks a large proportion in the case will have been destroyed.

The present-day methods of treatment of lemons in New Zealand show much improvement compared with those prevailing a few years ago. Picking of the fruit is now done monthly so that oversized fruits will be avoided, for, no matter how green in appearance a lemon may be, if it has attained the most desirable size it is ready for picking. The minimum size for picking is usually $2\frac{3}{8}$ in. diameter. Experienced pickers can tell at a glance the size of the fruit; pickers of less experience usually carry a ring with a diameter of $2\frac{3}{8}$ in. for measuring fruits of doubtful size. The fruit is severed from the tree by small secateurs designed for that purpose, and carefully placed in picking-bags. From the picking-bags the fruit is removed, one by one, into the orchard case, and then conveyed to the curing and packing depot. On arrival at the depot the fruit is graded. The yellow lemons are also separated from the green lemons. All of the better-grade fruit is placed in single-layer trays and stored in a curing-room specially constructed for the purpose, light being eliminated as much as possible and a moderate even temperature maintained.

These trays of lemons are looked over periodically, and any fruits showing signs of decay are removed. When the fruit has become thoroughly cured it is removed to the packing-room, where it is washed. When dried it is graded to size, for fruit with a difference of more than $\frac{1}{4}$ in. in diameter should not be packed in any one case. Every first-grade fruit is wrapped in tissue-paper, and packing is done systematically in new cases. The cases are wired at each end, so as to prevent breakage if roughly handled during transit to market.

Lemons treated in this way can be relied upon to keep at least three months after being put on the market without excessive wilting, and with a smaller percentage of decay than is general with much of the imported fruit. The chief advantages of a

properly cured lemon over an uncured one are that in the process of curing the thickness of the rind is reduced by about 50 per cent. without giving the fruit a wilted appearance and without reducing the juice content.

As regards New-Zealand-grown oranges, their former unpopularity has been principally due to the fact that until recently a large proportion of the fruit offered for sale was from seedling trees which produced a poor type of fruit. However, there is now a considerable area in Auckland Province planted with the best varieties. Many of these trees are now coming into bearing, and each year more of their good-quality fruit is being sold on the local markets.

In New Zealand there are two co-operative curing and packing depots for the handling and marketing of citrus fruits, one being at Tauranga and the other in Auckland. The depot at Tauranga is handling approximately 90 per cent. of the lemons grown in the Bay of Plenty, while the Auckland establishment handles a considerable quantity of citrus fruits grown in the vicinity of Auckland City and at Whangarei. These co-operative organizations have done valuable work in standardizing grades and in preventing the marketing of uncured and poor-quality lemons. Lower-grade but suitable fruit from these depots is sold to factories for use in connection with the manufacture of lemon juice and peel.

DAIRY FACTORIES IN NEW ZEALAND, 1929.

THE following table presents the registrations of factories under the Dairy Industry Act as at 30th April last, together with the quantities of butter and cheese forwarded to grading-stores for export during the year ended 31st March, 1929, and the numbers of milk or cream suppliers to the factories:—

District.	Number of Factories.				Forwarded for Export, 1928-29.		Number of Suppliers to Factories.	
	Butter.	Cheese.	Dual Plant.	Total.	Butter.	Cheese.	Butter.	Cheese and Dual Plant.
					Tons.	Tons.		
Auckland ..	60	36	6	109	52,136	12,753	17,760	1,320
Taranaki ..	23	75	33	171	7,780	35,996	2,780	3,567
Wellington ..	18	49	10	91	9,187	13,416	4,955	1,657
Hawke's Bay ..	12	16	2	35	4,008	4,160	4,030	592
Nelson	6	3	1	11	1,258	478	1,190	447
Marlborough ..	3	1	4	10	725	807	760	206
Westland ..	9	2	1	12	629	37	657	41
Canterbury ..	9	14	3	30	1,565	1,926	4,568	1,889
Otago and Southland	11	79	1	97	1,616	13,044	6,453	3,225
Totals ..	151	270	66	566	78,904	82,617	43,153	12,944

Whey butter was manufactured as a side-line at seventy-nine of the above cheese-factories in 1928–29, the total quantity forwarded for export being 1,324 tons. This is not included in the total amount of 78,904 tons of butter given in the table, which refers to creamery butter only.

In the 1928–29 period there were also operating in the Dominion six milk-powder factories (three whole-milk and three skim-milk plants), five casein-factories, two condensed-milk factories, and one sugar-of-milk factory.

SEASONAL NOTES.

THE FARM.

BETTER UTILIZATION OF PASTURE-GRASS IN DAIRY-FARMING.

AUGUST marks the start of a new dairying season, and dairy-farmers should now carefully consider the improvement of their pasture-management methods, so as to make the greatest possible use of the feed that will be produced by their grasslands during the season. At the present time the better utilization of the feed already produced by our pastures is probably more important than increasing grass-production by the more liberal use of fertilizers. In the long-settled dairying districts, where annual top-dressings of 3 cwt. to 4 cwt. per acre of phosphatic fertilizers are usual, the average farmer has reached a stage where it is extremely important that he adopt better methods of grass-utilization before embarking on a more extensive manurial programme. It is important to remember that although improved methods of pasture-management must accompany the more intensive use of fertilizers, it is not necessary, at any rate for a start, that the intensive use of fertilizers should accompany improved methods of utilization. Farmers should endeavour to use all the grass their pastures are already producing before endeavouring to greatly increase their grass-production. Extension of the practices of hay- and ensilage-making to conserve as much as possible of the surplus early summer production of grass for periods of grass shortage, and the adoption of improved methods of grazing, are of prime importance in improving our present methods of grass-utilization.

An increase in the area saved for ensilage should be the first forward step undertaken, and the storing-up of a large reserve of ensilage should always precede the adoption of more intensive methods of grass-farming and an increase in the numbers of the dairy herd. Besides providing a reserve of fodder for supplementary feeding during periods of poor grass-growth, the mowing of rank pastures during November greatly improves the subsequent pasture-growth. Pastures cut for silage in November produce much more feed in the autumn than pastures cut later for hay.

Grass ensilage made in pits or trenches requires much less manual labour than where the material is stacked in the field. Indeed, it is really much easier to convert the material into silage, where the pit method and horse-sweeps are used, than to make it into hay. The storage of some of the surplus production of grass as ensilage should therefore become just as much a matter of routine on dairy-farms as the making of hay.

An improvement in grazing methods will increase the carrying-capacity of grassland without unduly raising the cost of production of farm-products. The close subdivision and rotational grazing of the best grassland of the farm will greatly raise its carrying-capacity, and leave a large surplus of grass on the rest of the farm

for conversion into hay and ensilage. Close subdivision and rotational grazing are also important factors in improving the turf on pastures. Pastures which are allowed to get rank, or on which the grazing is uneven, or which are subject to close and continuous grazing, tend to deteriorate, while rotational grazing helps to build up a rye-grass and white clover pasture. Dairy-farmers cannot hope to obtain a long, high-producing lactation period from their cows unless perennial rye-grass forms an important element of the pasture sward, for rye-grass throws good feed in the early spring when most other grasses are practically dormant.

ARABLE CROPPING WORK.

The sowing of spring cereals and the ploughing of land for spring- and summer-sown root and forage crops will keep the teams or tractor busy in the coming month on all days the land is fit for working. Normally the spring operations can be lightened by making every endeavour to get the stubbles intended for root and forage crops turned over in the early winter; and grassland intended for turnips and rape should be ploughed if possible before the sowing of spring cereals. Early ploughing, besides increasing the amount of moisture held in the land for the use of crops, exposes the soil to the weathering agencies of the atmosphere, and the breaking-down of the soil under the influence of the weather will lessen the amount of cultivation work necessary in the spring to obtain a fine seed-bed.

In dairying districts of the North Island there is normally no imperative need for the early winter ploughing of grassland for root and forage crops, owing to the high rainfall experienced. The land should be broken up by the middle of August, so as to allow sufficient time for the grass-sod to rot before the crop is sown.

PRODUCTION OF EARLY SPRING FEED.

August and September are usually difficult months on dairy-farms. If the weather is cold there is usually little grass-growth until the end of September. Top-dressing in the autumn and shutting up pastures in June allows a good deal of the winter growth of grass to be saved for the spring, but this growth is usually finished by the middle of August, and production often falls during late August and early September. The ability of winter dressings of nitrogen to produce good early spring feed will again be watched with interest during the coming months, and if the use of these nitrogenous fertilizers is shown to be a payable proposition one of the greatest difficulties in the satisfactory feeding of dairy cows in the early part of the season will have been surmounted.

—*P. W. Smallfield, M.Agr.Sc., Fields Superintendent, Auckland.*

CARE OF DAIRY COWS DURING THE WINTER MONTHS.

Most of the dairy herds are now dried off and the cows are having a much-needed rest from production. There are several methods of drying-off cows; the main object should be in all cases to leave the udder in such a condition that the tendency to inflammation in the organ is reduced to a minimum. The usual method is to gradually

increase the time between each milking. In the case of the more high-producing animals considerable difficulty is experienced at times in drying-off. It would appear that nothing short of starvation in these comparatively few cases is sufficient to prevent milk-secretion, and in such instances it is better to continue milking throughout than to deprive the animal of a sufficient food-supply.

The pregnant cow, whether producing or not, has to meet the demands of a developing fœtus, besides maintaining her condition, or, as is more to be desired, the replacing of a deficit resulting from the past season's production, and also a reserve for the ensuing season's production. Good ensilage as a foodstuff is superior in feeding-value to roots alone, and about equal to roots combined with a liberal allowance of good hay. Inferior ensilage, on the other hand, has a low food-value, due to the effect of harmful acids of fermentation.

In connection with winter feeding, especially where roots or chou-moellier form the major portion of the ration, there is a danger of the trouble known as "red-water" occurring. This trouble is apparently due to too much bulky watery feed, and can be prevented by combining hay with the root ration. Moreover, the cow is more benefited and maintains better condition when roots are not used to excess, and when fed in conjunction with a quantity of well-saved hay. Lucerne hay or clover hay is more valuable on account of its containing a higher percentage of calcium and protein, very necessary elements in the development of the unborn calf. Frosted roots are dangerous, as they may cause severe indigestion and bloating.

Occasionally trouble is experienced when feeding ensilage to cattle, and here again the excessive use of ensilage alone is in many cases the cause of the trouble. An attempt should be made to combine hay with a watery food such as ensilage, roots, and chou-moellier. In far too many cases no attempt is made to balance the cow's winter ration on account of a shortage of concentrates, but, where available, a small dairy ration of a concentrate rich in protein, such as some of the recognized cattle-cakes, should be used. From experiments it has been shown that the extra return in milk-yield from cows receiving a concentrate ration has more than paid for the increased cost of feeding. There is also the satisfaction that an attempt is being made to balance a ration which is otherwise much too bulky, with an excess of water and starches. It is a noteworthy fact, also, that in town-supply herds, where concentrate feeding in winter is necessary to maintain the milk-supply, many troubles to which dairy cows are prone are not so prevalent. In connection with the feeding of mangels to cows, occasionally it is forgotten that these roots require to be stored for some weeks before feeding. If the foregoing points are borne in mind a considerable red ction in the winter mortality of dairy cows from digestive troubles should be effected.

Almost every winter cases are reported of cows dying from paralysis before or after calving. On investigation it is quite apparent in some cases that the animals have not received sufficient food during the winter. If cows are worth keeping it always pays to feed them well; a scarcity of winter feed is merely a question

of mismanagement of the balance between summer and winter requirements. It is always safe to provide a quantity of hay in excess of apparent requirements. Any excess may be held over, or may be fed with advantage during the spring months.

A saving of winter feeding may be effected by the provision of shelter and warmth. In the digestion and absorption of food a certain amount is required to repair waste, to maintain condition, to provide for the developing calf, and to maintain the heat of the body. If, then, the heat of the body is maintained by the provision of shelter from hedges, or by the use of covers for the cattle, less food is required for heat-production, with a consequent improvement of condition in such animals. In many cases also the method adopted of feeding out hay in the paddocks is a wasteful method, a portion being lost through being trodden into the ground and destroyed by rain. The feeding of hay out of movable racks has an advantage over the usual broadcast method.

In conclusion, the building-up of condition and reserves in the animal helps to ward off attacks of disease. The animal's resisting-powers are reinforced by good feed, and as a consequence one may expect less trouble from paralysis and other ills which occur about calving-time.

—*Live-stock Division.*

THE ORCHARD.

SPRAYING.

EARLY next month will mark the beginning of a new season's activities in the control of pests and diseases. As this is one of the main factors in fruit-production, and success depends on months of well-directed effort, a brushing-up of one's knowledge of control methods now will prove helpful. The spraying diary recommended by the writer some time ago, if such has been kept, might be studied also with the idea of putting into practice lessons it may have taught. Spraying-materials should be ordered, and the spraying outfit put in readiness. The overhaul of the spray outfit should be given a place of preference on the list of wet-day jobs during the winter. Then the fruit-grading machine will require a good cleaning and the making of adjustments. Picking-boxes could be repaired and renailed, and all implements cleaned and oiled.

A good working knowledge of the materials used in spraying may be gained from studying the Department's bulletin on "Control of Orchard and Garden Pests and Diseases." The various materials recommended, and their uses, may be briefly summarized as follows:—

(1) Poisons for chewing and biting insects: Arsenate of lead is almost universally used for control of such chewing-insects as codlin-moth, leaf-roller caterpillar, and pear or cherry slug. Fruit and foliage must be kept thoroughly covered with the spray, and applied in anticipation of attack.

(2) Contact sprays for sucking-insects: Red oil has proved most effectual for such pests as mussel, San Jose, and other scales, aphides,

pear-mite, thrips, &c., and is used towards the end of the dormant period or as the buds show some movement. Contact sprays are applied when the pest is actually present. Other contact sprays used for certain purposes are lime-sulphur and Black Leaf 40. Lime-sulphur is very useful in the control of red mite and San Jose scale, mostly as a summer insecticide; it is, however, used chiefly as a fungicide, and as such serves both purposes. Black Leaf 40 used as an insecticide in the growing-period, acting as a fumigant, controls such pests as leaf-hopper and aphides.

(3) Fungicides for the control of fungus diseases: Lime-sulphur, bordeaux, and finely precipitated sulphur have their specific uses, and are employed in the control of such diseases as black-spot on apple and pear, leaf-curl on peaches and nectarines, bladder or pocket plum, powdery mildew on apples, shot-hole fungus on apricots, and brown-rot on stone-fruits.

Stone-fruit requires attention first, and the necessity for using an insecticide should be determined on the condition of the trees. Red mite and San Jose scale, if present, would require treatment with oil, making an application at 1–17 immediately before bud-movement. It is necessary at this particular time of the year to select a good sunny day for applying oil, so as to ensure better penetration into cracks and rough surfaces. Where there is a heavy infestation of scale the only satisfactory means of dealing with it is to remove the heavily-infected branches and spray thoroughly the remaining portions. Badly infected branches located during picking operations should be marked at the time.

Bordeaux is used a little later, at a strength of 8–6–40, for the control of leaf-curl, shot-hole, bladder-plum, and peach-rust. This application should be made when the buds begin to swell. Delaying this spray till the blossom-buds are expanded may allow spores of leaf-curl and shot-hole to become active and infection to take place. On varieties liable to severe attack a second bordeaux spray, at strength 3–4–40, may be applied when colour is showing in the buds. The practice of applying an oil spray following bordeaux is not recommended, as the application of oil so delayed necessitates such a reduction in strength as to render it of little use, otherwise buds are damaged. Bordeaux may be applied following closely after oil if a spreader is used.

COMPLETION OF PRUNING.

Pruning should now be well in hand, and every effort made to complete it before there is any movement in the buds. Any interference with the tree during the growing-period causes a check, and on weak trees is particularly undesirable. Trees which still appear too heavily spurred and which made but poor growth should receive especial attention in the way of extra spur-pruning, so as to reduce the amount of blossom and encourage growth. Heavy spur-pruning, leaving the stronger and younger spurs, will frequently cause quite a burst of growth from fruit-spurs, and often gives better results than a drastic cutting-back of a tree that requires renovating.

All prunings should be gathered and burned as a sanitary measure in the control of disease. By using a pruning-sheet of

hessian or other material the gathering of prunings is made easier and complete. A pruning-sheet requires to be a square, the side of which is equal to the distance between trees, with an opening from the middle of one side to the centre and bound on the edges. Two men working together can readily shift the sheet from tree to tree.

PLOUGHING AND MANURING.

Where the ground is in suitable dry condition cover-crops should be ploughed in. Trees should be dug round before the spring to bury all leaves and rubbish. Most lands require occasional limings, and lime may be applied at any convenient time during the winter. Probably an average of 1 ton per acre every three years will suffice. It is better to spread the lime prior to ploughing. Fruit-trees require annual applications of fertilizers if heavy and regular crops are to be expected. The general application of fertilizers may be deferred till nearer the spring. However, if slower-acting organic manures such as blood-and-bone are to be used, applications may be made now with advantage.

REWORKING OF TREES.

Many varieties which at one time were regarded as quite profitable to grow, having their particular virtues, are now, through changed conditions, regarded as inferior and unprofitable in the main. Such trees may be worked over to more suitable varieties by grafting. The operation is performed in the spring. Scions should be selected now, taking medium-sized last year's growth and preserving them in good fresh condition by heeling-in in a place which is cool, shaded, and sufficiently moist but not wet. Trees which through overcropping, neglect, and other causes have become debilitated may be rejuvenated by working over in the same manner.

Trees intended for working over could now be cut down to within a few inches of the height at which it is intended to graft. This saves much time in the spring if much grafting is to be done. The final cut is then made at the time of the grafting operation. The choice of variety is a matter which cannot be covered by a general recommendation. Local conditions, existing varieties in the orchard, and suchlike considerations must guide one largely, and it would be better to consult the nearest Orchard Instructor in regard to such an important matter.

—N. J. Adamson, Orchard Instructor, Hastings.

Citrus-culture.

Land may now be prepared for new plantations, careful consideration being given to providing adequate shelter and thorough conditioning of the ground. Good drainage is the first essential. If the land is not of such a porous nature as to permit the excess water to percolate away readily under-drainage must be provided. Tile drains of suitable dimensions according to the length of drain are preferable, but if for financial reasons these cannot be provided, drains of logs and brushwood will give good service for some years. A thorough working of the upper subsoil is also advisable, but it

should be done uniformly over the whole area with a subsoil-plough, not merely by digging under where the tree is to stand. This latter method is bad practice, as it encourages the water to stagnate locally to the detriment of the tree. General surface levelling should also be done while the area can be regulated without interference from trees. Throughout the whole preparation it should be remembered that working the land when it is not in a fit state will have a compacting effect difficult to correct later. It is better to delay operations until the soil works freely.

Varieties of lemons recommended for planting are as follows:—Lisbon: The well-known variety of constant and early cropping habit practically all the year round, but heaviest in late winter. Eureka: Quite as desirable and fruitful as Lisbon; the tree is practically thornless, and the main crop carried in summer. Meyer: A recently introduced variety of special merit for domestic planting; more frost-resisting than Eureka or Lisbon

Among preserving-oranges, the Poorman yields a heavy and constant crop wherever citrus fruits can be grown. Medium to large fruits, the largest of which may be used for breakfast purposes. Season of harvest May to September.

In sweet oranges the following are recommended:—Navelencia: A good orange of late season. Valencia Late: A navel orange of late season. Lou Jin Jancy and Pineapple: Varieties of recent introduction with great promise; they should be tried in a limited way.

—W. H. Rice, Orchard Instructor, Auckland.

POULTRY-KEEPING.

HATCHING OPERATIONS.

BREEDERS are reminded that August and September may generally be regarded as the best months of the year in which to hatch out the main crop of chickens for the production of eggs during the winter season when high prices rule.

Thus every endeavour should be made to secure the required number of young stock before the end of September. It should be remembered that the right season extends over a very short period. Chicks brought out on the early side—say, early in July—are apt to go into a moult just when high-priced eggs are expected. On the other hand, if the hatching is delayed until the approach of summer the chickens will fail to produce until the following spring, when low prices for eggs prevail. Not only this, but such stock seldom grow to a desired size, and consequently lay small-sized eggs, besides always being more susceptible to every passing ailment than are the earlier-hatched birds. The margin of profit to be made from late-hatched stock is low, even in normal times, but the present high cost of foodstuffs facing the poultry-keeper, and the existing general tendency towards cheaper eggs, may easily mean a loss instead of a gain.

In the case of those who have to depend on the natural mother for hatching purposes the difficulty of securing chickens during

August and September is realized, as at this period of the year broody hens are scarce, and as a result hatching operations are delayed beyond the most desirable season. Rather than delay on this account, however, the better plan is to resort to artificial methods, either by purchasing an incubator or by securing day-old chicks. The latter method as a means of overcoming the difficulty of securing broody hens when most required is an ideal one for the man in a small way, providing the chicks are procured from a reliable breeder of heavy-laying stock. With a fireless brooder made from a petrol-case, as illustrated in the Department's bulletin "Utility-poultry Keeping," these day-old chicks can be satisfactorily reared when the necessary attention is available. In this way chickens can be secured at a season when they will have every opportunity of developing well and of coming to a laying-point at the most profitable stage.

ARTIFICIAL INCUBATION.

Hatching chickens by means of incubators is an important work in connection with the poultry plant, but it is one of the most difficult matters on which to guide the novice by means of printed advice. There are so many different styles of machines, and such considerable variation in the methods of providing the necessary temperature, ventilation, and moisture, that it is impossible to lay down any general instructions which will suit all machines alike. The best advice to the novice is that before starting he should carefully study the instructions sent out by the maker regarding the working of the particular incubator he proposes to use. The novice would also be well advised to select an incubator from among those makes that have proved their value to our successful poultrymen, rather than be led into buying a cheap inferior article on a trade advertisement only. It is only safe to depart from the maker's instruction when the operator has had considerable experience in incubation work, or when he is following the advice of a man of wide knowledge in artificial hatching.

No two incubators on the market require exactly similar treatment, but there are certain rules which can be applied to all machines. For example, if eggs are to hatch out at the right time the correct range of temperature must be maintained throughout, the thermometer must be located accurately, so that the recorded temperature is being experienced in the right place—that is, in a line with the top of the eggs. The germ of an egg floats uppermost, irrespective of the position in which the egg is resting. Thus the necessity for having the bulb of the thermometer resting on the top of a fertile egg will be seen. Stale eggs will always take longer to hatch than those that are fresh, and allowance must be made for this. Eggs intended for incubation should be placed in the incubator as soon after being laid as possible. Eggs will often retain their hatching-qualities when a month old or even older, but usually the chicks produced from these are delicate and difficult to rear.

Reverting to the matter of temperature, this should be maintained at about 102° F. for the first week, 103° for the second and

third weeks, and 104° when hatching. If after having followed this range of temperature the eggs do not pip up to time, the only safe course to take with the following hatch is to work a degree higher, as it goes to indicate that the thermometer is not registering the correct degree of temperature. It is important that every care should be taken to prevent an excessive degree of temperature in the incubator, or trouble may be expected during the brooder stage, through the yolk of the egg failing to become absorbed. The yolk is drawn into the body of the chick just before it leaves the shell, and under proper incubation conditions the yolk in its sac will be found in a more or less liquid state, enabling it to run freely, and finally to become absorbed. On the other hand, where the temperature has been allowed to go too high during the whole or part of the incubating period the yolk becomes half-baked, rendering it incapable of absorption. Once a chick becomes affected in this way little or nothing can be done for it, as usually it will succumb at some time during the brooder stage. Prevention is the one thing to aim for, and the first essential in this connection is the maintenance of an even temperature during the incubation period.

ARTIFICIAL BROODING.

Probably the greatest cause of mortality in artificial brooding is allowing chicks to huddle, this being usually induced by not providing the little birds with a uniform degree of warmth. Huddling means sweating, and its effect is manifested in several ways, the chief of which is a chill when the chickens leave the brooder. This brings on a weakened state, which is usually manifested by bowel trouble and a general lowering of vitality. Another effect of chill is a weakness of the legs and a wobbling walk, indicating that the chickens are huddling at night and require more warmth. The young birds, feeling the need of more heat, huddle in the corners of the brooder, each one trying to secure an inside position, which is the warmest. The trouble is often intensified by a lack of sufficient bedding on the floor, especially when the floor is very smooth, when the constant slipping on the smooth surface during the huddling effort has the effect of spreading and weakening the delicate legs. On the first sign of this condition being observed additional warmth should be applied, by means of extra flame in a heated brooder and extra covering in the case of a fireless brooder. The aim should be to make the chicks comfortable, as only in this condition can they be expected to thrive. If the chicks are spread over the floor of the brooder it may be taken for granted that the degree of warmth being maintained conforms to that demanded by instinct, whereas if they are huddling it is a sure sign that more heat is required. When chicks have acquired the habit of huddling in corners, as a result of chill, it is often difficult to break them of it. In artificial rearing it is always a waste of time to try and rear weaklings, as they seldom or never develop into profitable stock. Not only this, but usually they are the first to acquire the habit of huddling, and teach the stronger birds to do likewise, with consequent heavy mortality.

—F. C. Brown, Chief Poultry Instructor, Wellington.

THE APIARY.

PREPARATIONS FOR THE NEW SEASON.

DURING the dormant season every spare moment should be spent in making preparations for the next season's work. All defective supers, roofs, and bottom-boards should be overhauled, and where necessary given a good coat of paint. This work, if delayed, is apt to interfere with the main work in the apiary when the bees are calling for special attention, and should not be postponed.

If it is desired to increase the apiary, hive and frame making should be pushed on, and ample provision made for increase before the actual time arrives for putting preconceived plans into operation. Where the beekeeper does not make his own hives he should now order sufficient stocks to see him through the season. In the majority of cases it does not pay him to make his own appliances. Hive-manufacturing in the Dominion has been brought to a high standard, and unless the apiarist has ample capital to purchase machinery to turn out good hives he will find the home-made article too costly in the long-run. Whether the beekeeper is working on a small or large scale, he should aim at uniformity, and in building up an apiary decide at the beginning on the style of hive and frame he is going to use, and continue on those lines. Non-fitting supers and frames mean extra labour, and lead to endless trouble. The sizes in use are mostly ten- and twelve-frame, and experience of his district will enable the beekeeper to decide as to the best one to adopt.

To meet those cases where cost is a consideration, a durable frame hive which will comply with the provisions of the Apiaries Act can be made out of a petrol-case. Petrol-cases are obtainable for a few pence, and can be readily converted by any one handy with tools. A kerosene-case may also be used, but it will be found necessary to reinforce it, so that the petrol-case is the handier. Particulars of a cheap home-made hive are given in the Department's Bulletin No. 128, "Beekeeping."

Overhauling the hives: As advised last month, all supers should be removed and the bees confined to the brood-chamber. This will keep the bees snug and promote brood-rearing, and at the same time facilitate the work of giving the hives their first spring overhaul. During the course of the winter there is usually an accumulation of pollen, dead bees, &c., on the bottom-boards, and consequently the latter require cleansing. All operations at this period should be carried out quickly as a safeguard against robbing. To cleanse the bottom-board a spare one should be brought into use. Set the hive temporarily on the spare board while scraping and cleansing the permanent one, then replace the hive on its permanent stand. See that the hives have a slight cant towards the entrance. This will prevent moisture settling on the bottom-board, which is apt to cause the death of a considerable number of bees, besides making the hive damp and unwholesome.

SPRING WORK.

During August, whenever the temperature will allow, the colonies may be given their first examination. It is highly important that this work should not be postponed until brood-rearing has started in earnest, more especially in cases where ample stores were not left to carry the bees over early stages of this important function. Delay in making an examination may lead to spring losses, and nothing is more annoying than to find colonies dead through neglect to provide sufficient stores. Usually a colony's requirements are attended to in the late autumn, when the apiarist endeavours to gauge the amount of food requisite to carry the bees through the winter and spring periods. It may happen, however, that mild weather is experienced, when the drain on the stores to feed the young bees, if not supplemented, will reduce a colony to starvation. Nothing should be left to chance during the critical months of spring, and no effort spared to see that each individual colony has sufficient food to meet current demands. Colonies which contain 15 lb. to 20 lb. of honey may be left until a later examination. If the hives contain less they should be watched closely and preparation made for feeding. See Bulletin No. 128, page 27, regarding the spring feeding of bees.

QUEEN-RIGHT COLONIES.

The most important factor in a colony's condition is its queen. Advantage should be taken of the first examination to see that the queen is all right. If a colony is in normal condition as regards strength and stores there should be fair-sized patches of brood in the centre frames, but this is not sufficient to determine that the colony is queen-right. The cells adjacent to the brood should be quickly examined for eggs, which are the only indication that the queen is present. If neither brood nor eggs are found, then shelve the question of the colony being queenless till about ten days later. At each examination make a note of each hive and its condition for future reference.

—E. A. Earp, Senior Apiary Instructor, Wellington.

HORTICULTURE.

THE TOBACCO CROP.

THE plant-beds should now be prepared ready to receive the young seedlings, which will be ready for pricking out towards the end of August or early September. A warm, sheltered, well-drained position should be chosen for this work. It is customary to sterilize the soil where the plant-beds are to be made, by burning a quantity of brushwood on the site. A few rather large pieces of wood may be placed across the plot to create a suitable draught, and on them brushwood, straw, &c., piled to a height of 3 ft. to 4 ft., and weighed down with a few pieces of heavy timber. This should be lit when the weather conditions will permit of a steady burn, and the heat will thus destroy most of the weed-seeds, insects, and fungus pests liable to attack the crop. When the

land has cooled, remove the larger fragments remaining, and broadcast a mixture of 3 lb. superphosphate and 4 lb. carbonate of lime on an area 12 ft. by 4 ft.—the size of the average nursery bed. This should be mixed well with the soil to a depth of 4 in. to 5 in., and reduced to a fine friable tilth.

To protect the plants a 9 in. board should be placed round the beds to hold the scrim or cheesecloth shade cover used after planting. To prevent this cover from sagging, cross-battens are fixed across the beds at intervals. If there is any danger of flood-water scouring the site, a trench should be dug on the high side and given a suitable outlet to carry the water away; or if the drainage is not all that could be desired the bed should be raised 5 in. to 6 in. above the normal level.

To enable the work of planting out to be done neatly and quickly a planting-board is necessary. It is best made of heart matai wood, the length being 3 ft. 9 in., thickness ¾ in., and width 4 in., while on one edge a double 2 in. bevel should be made.

Where nursery plants are not obtainable these plant-beds may be sown down with seed. Before doing so see that the soil is moist and in suitable condition. A teaspoonful of seed is sufficient for 100 square feet of bed, and to enable an even distribution to be made it is customary to mix it well with about twenty times its own bulk of sifted wood-ashes or dry sand. Sow evenly, first crosswise and then lengthwise, and afterwards tread the seed in or pat it down with a spade. The boxing should then be placed in position, and the cloth cover securely fixed. Sometimes a closely woven fabric has been used for this purpose, and the seedlings have damped off for want of ventilation; this is a mistake that should be avoided.

Next in importance to good seed-beds and plants is a well-prepared field in which to set them out. This is where many new growers have failed. Where grassland is to be used it should be skim-ploughed, and, when the turf is well rotted, deeply cross-ploughed as before stated. This deep ploughing, which should be done in early winter, may be followed by a light ploughing towards the end of this month, and the land well broken down with disk harrows.

TOMATOES AND SMALL-FRUITS.

Tomato-plants for the cool glasshouse should now be well advanced. Water them sparingly with tepid water as necessary, and give them air during the warmer hours of the brighter days. Close the house up tight early in the afternoon to retain the heat. The land in houses where the crop is to be raised should now receive what manures are required, and the final cultivation be given before planting out towards the end of August. The soil should be firm and well settled before planting is done, and houses in which the soil has been allowed to dry out should be thoroughly saturated with water some time previous to planting. Tread the plants in firmly after planting, and keep the house closed for a few days until they are well established. A temperature of 55° to 65° F. should be maintained, and remember that any check given to the plants at this period will be at the expense of the early fruit. Plant in shallow drills, and use tepid water when necessary.

Plants left over are sometimes hardened off for planting outside in October and November, but this is a mistake, as they remain too long in the boxes and thus receive a check in growth from which they are slow to recover. Seeds for the outside crop should be sown now, and a foot or two of fermenting stable manure in a cold frame is a very suitable place in which to raise them in most districts. Such plants make a continuous growth without a check, and do better in every way.

In the small-fruit section, apart from the spraying of strawberries, attention should now be given to shallow hoeing in fine weather for the purpose of breaking up the surface crust and destroying seedling weeds. Deep cultivation at this season of the year, with injury to the fibrous roots which lie near the surface, is a common cause of serious losses in these crops.

THE MARKET-GARDEN.

Plantings of autumn-sown onions, lettuce, cabbage, and cauliflowers made last month, also sowings of lettuce, radish, spinach, onions, and broad beans, should be given first consideration in fine bright weather, and lightly hoed to destroy seedling weeds before they gain any size. In addition to the foregoing, plant now artichokes, shallots, asparagus, and early potatoes. Also sow shorthorn carrots, turnip-rooted beet, parsnips, main-crop onions, parsley, and early turnips.

In many cases sowings of cabbage and cauliflower for early summer cutting should be considered by those who have suitable land; also asparagus for planting out twelve months hence. Work the surface soil down to a fine tilth before sowing, and sow thinly and so save seed and much of the labour of thinning. To protect seed-peas from vermin sprinkle them with kerosene and red-lead; stir them well to distribute the dressing, and spread them out to dry before sowing.

Complete the preparation of land for the sowing of main crops in September, and half-hardy crops in October. Seeds of a good variety and strain and suitable land well prepared are the main secrets of successful cropping.

HOME GARDEN AND SPORTS-GROUNDS.

The planting season for hard-wooded plants ends with the month of August in most districts, and work of this kind should be completed as soon as weather permits. New lawns may be sown down during the coming month. On old greens burn out weeds and stimulate the grass with dressings of sulphate of ammonia. If this is done later in the season the patches will hardly recover sufficiently well before summer playing begins. Where the playing is hard an area of turf should be specially grown for patching at any time. Ample reserves of turf should be held for this purpose, giving the green every attention in order that the requisite condition may be maintained.

—W. C. Hyde, Horticulturist, Wellington.

TESTING OF PUREBRED DAIRY COWS.

C.O.R. LIST FOR JANUARY TO JUNE, 1929.

Dairy Division.

THIRTY-SEVEN cows received certificates-of-record during the six months ended 30th June, 1929, this being the slack period for the C.O.R. system. It will be noticed that a number of good performances are recorded in the appended list, which is a creditable one generally from the point of view of production.

* Cow milked three times daily during whole lactation period. † Milked three times daily during part of period.

Name of Cow and Class.	Tested by	Age at Start of Test.	Fat req'd for Cert.	Yield for Season.		
				Days.	Milk.	Fat.
	JERSEYS.	Yrs. dys.	lb.		lb.	lb.
Junior Two-year-old.						
Elcho Bonny ..	C. J. Masters, Hunterville	2 91	249·6	365	10,909·8	582·38
Takapu May ..	R. C. Jury, Tikorangi ..	2 54	245·9	365	8,860·3	484·19
Majesty's Bonny Duchess	G. Hodgson, Whakapara ..	1 236	240·5	365	6,860·0	423·95
Roslyn Confetti ..	H. Smith, Patumahoe ..	2 30	243·5	351	5,277·9	334·24
Springhill Buttercup	H. Smith, Patumahoe ..	1 270	240·5	358	5,367·4	333·93
Bethune Rosina ..	A. S. W. Hazard, Waimate North	2 7	241·2	257	7,258·2	324·47
Crofton Polly ..	F. H. Noffke, Halcombe ..	1 328	240·5	275	5,062·8	318·93
Highsteads Quality ..	F. E. Day, Tamahere ..	1 265	240·5	365	5,039·6	272·97
Senior Two-year-old.						
Okauia Leaflet ..	R. K. Garland, Matamata	2 287	269·2	364	8,363·6	432·84
Orange Dale Elva ..	W. Hall and Son, Matatoki	2 343	274·8	268	6,117·1	306·73
Three-year-old.						
Ferndale Viola's Duchess	J. J. Springgay, Gisborne ..	3 131	290·1	365	8,889·5	471·09
Pinedale Flirt ..	H. Lewis, Waharoa ..	3 67	283·7	360	8,556·2	404·69
Gay Lady	F. E. Day, Tamahere ..	3 321	309·1	328	5,583·7	343·32
Four-year-old.						
Rewa Friday ..	A. Christie and Co., Hikurangi	4 37	317·2	365	10,431·8	583·85
Conqueror's Jess ..	Kilgour Sisters, Kiwitea ..	4 9	314·4	281	9,604·0	501·85
War Bride of Puketapu	T. H. Western, Bell Block	4 191	332·6	351	9,019·0	538·22
Ku Ku Sunbeam ..	J. Leslie, Ohakune ..	4 36	317·1	307	9,085·8	460·73
Green Park Tiny ..	J. T. Warman, Katikati ..	4 149	328·4	347	7,929·7	406·58
Mature.						
Noble Fernleaf ..	G. Hodgson, Whakapara ..	7 4	350·0	365	12,413·7	612·93
Rewarder's Golden Berbery	F. C. Butt, Opotiki ..	5 357	350·0	365	11,223·0	602·90
Elf's La Primevere ..	J. Robb, Wanganui ..	6 158	350·0	365	8,154·1	480·88
	FRIESIANS.					
Junior Two-year-old.						
Pareora Ethel Echo*	A. S. Elworthy, Timaru ..	2 99	250·4	365	17,344·9	583·29
Senior Two-year-old.						
Hillside Leila* ..	Mickell Bros., Te Horo ..	2 189	259·4	365	17,003·0	761·60
Hillside Burkeyje Blanco*	Mickell Bros., Te Horo ..	2 341	274·6	365	12,858·5	560·01

HILLSIDE LEILA (MICKELL BROS., TE HORO).

C.O.R. in senior two-year-old Friesian class: 17,003 lb. milk, 761·6 lb. butterfat.

FLANDRINE'S VIXEN (R. E. CLEMENTS, DARGAVILLE).

C.O.R. in Jersey mature class: 12,598·8 lb. milk, 722·42 lb. butterfat.

LIST OF RECORDS—*continued.*

Name of Cow and Class.	Tested by	Age at Start of Test.	Fat req'd for Cert.	Yield for Season.		
				Days.	Milk.	Fat.
		FRIESIANS—*continued.*				
		Yrs. dys.	lb.		lb.	lb.
Junior Three-year-old.						
Totara K.P. Dorothea*	Piri Land Co., Auckland ..	3 108	287·8	343	17,731·3	619·29
Senior Three-year-old.						
Pareora Model Cadillac*	A. S. Elworthy, Timaru ..	3 302	307·2	365	16,804·2	604·21
Junior Four-year-old.						
Rosevale May Echo Beets*	H. North and Sons, Omimi	4 33	316·8	365	17,863·9	654·53
Senior Four-year-old.						
Totara K.P. Colantha*	Piri Land Co., Auckland ..	4 199	333·4	321	16,932·5	617·15
Mature.						
Taumata Tillyveld†	Oakview Stud Farm, Auckland	5 265	350·0	347	22,236·5	721·65
Rosevale Burkeyje Sylvia*	H. North and Sons, Omimi	10 108	350·0	364	19,424·0	692·85
Pareora Cherry Blossom*	A. S. Elworthy, Timaru ..	7 202	350·0	365	17,192·6	596·38
	MILKING SHORTHORNS.					
Junior Four-year-old.						
Riverdale Dolly 5th†	T. W. Wardlaw, Waimana	4 125	326·0	365	14,533·1	568·66

Second-class Certificates.

Jerseys.

Junior Two-year-old.						
Tinsel's Dovelet ..	J. Gaddes, Morrinsville ..	1 352	240·5	282	6,486·1	371·40
Senior Two-year-old.						
Elcho Fay ..	C. J. Masters, Hunterville	2 189	259·4	365	10,271·4	618·19
Four-year-old.						
Okauia Bangle ..	R. K. Garland, Matamata	4 28	316·3	365	6,185·6	402·87
Mature.						
Jersey Farm Pet ..	H. R. Benbow, Ormondville	5 41	350·0	365	10,063·7	560·78
Miss Doreen ..	R. Haylock, Ngaere ..	5 63	350·0	294	10,203·0	555·71

Howard Estate Advisory Board.—The following have been appointed members of this Board under the Howard Estate Amendment Act, 1927, for the triennial period ending May, 1932: E. Averill, W. Cuthbertson, A. Robottom, J. H. Absolom, J. Livingston. Mr. Averill is named as chairman.

Bone-char.—Bone-char, which appears among the importations of fertilizers into New Zealand, is a substance used as a clarifying and decolorizing medium in the production of cane-sugar. The spent material is used as a source of phosphate in the preparation of mixed manures.

WEATHER RECORDS: JUNE, 1929.

Dominion Meteorological Office.

GENERAL NOTES.

JUNE began with good weather in continuance of the fine and dry conditions which had been the rule during May. General rains were recorded between the 7th and 12th, with many heavy falls in districts with a westerly aspect, but the weather was otherwise mainly fine and unusually mild until the 19th. From the 19th to the end of the month squally, boisterous weather, with heavy rains, was general. Unusually heavy snowfalls were experienced in Otago and Southland on the 28th and 29th.

Rainfall was much above the normal in the greater part of both Islands, although a few stations in Taranaki, Hawke's Bay, and North Auckland had less than the average. The May deficiency was thus made up, and any fears of a winter shortage were dispelled.

Temperatures were generally above the average for June, and there were few severe frosts, especially in districts north of Canterbury. The comparatively mild conditions, combined with the heavy rains, maintained a good growth of pasture. Many plants usually dormant at this time of the year are sending forth shoots or producing flowers. At Wellington, for instance, blossoms have appeared on numbers of pohutukawas. The bad weather of the latter end of the month affected the condition of hoggets to some extent, but otherwise stock are reported as doing well.

Many places recorded rather less than the average amount of sunshine.

Although the pressure systems again included a number of cyclones, the month was notable for a return to the westerly type of weather. This was particularly pronounced from the 22nd to the end of the month. A cyclone in the north Tasman Sea in the early days of the month passed without affecting New Zealand to any extent, and anti-cyclonic conditions and fine weather ruled until the 4th. A second cyclone of only slight intensity crossed Otago on the 7th, and was followed by a more vigorous one, the centre of which moved rapidly across Westland and Canterbury, on the 11th. Thereafter until the 18th fine weather, associated with a well-developed high-pressure system, was experienced over most of the country. During the 19th and 20th a cyclone which had developed suddenly in the south-west Tasman passed through Cook Strait, where the pressure fell almost to 29·0 in. This storm was accompanied by very heavy rains and severe gales, especially over the North Island.

The westerly weather already referred to then began to control the situation. From the 24th onwards the pressure difference between northern and southern places became large. In other words, pressure gradients became steep. Thenceforward until the end of the month strong winds blew almost continuously from between west and south. In western districts, especially in the North Island, gale force was experienced for much of the time. The period was remarkable for the number of tornadoes occurring. The most severe was one which struck the outskirts of Palmerston North at 3.25 p.m. on the 24th. A number of houses were damaged, trees were uprooted, and telegraph-poles levelled. Onaero, north of Waitara, experienced a less violent tornado on the 26th, and the Rotorua district another on the 27th. These whirls were accompanied by severe thunder and hail. Many other places also recorded thunder and hail storms. A number of stock were killed, and several human beings received shocks, two persons being rendered unconscious.

—*Edward Kidson, Director of Meteorological Services, Wellington, 6/7/29.*

RAINFALL FOR JUNE, 1929, AT REPRESENTATIVE STATIONS.

No.	Station.	Total Fall.	Number of Wet Days.	Maximum Fall.	Average June Rainfall.
	North Island.				
		Inches.		Inches.	Inches.
1	Kaitaia	8·21	16	1·99	5·53
2	Russell	4·30	16	1·30	7·14
3	Whangarei	5·88	21	2·15	6·22
4	Auckland	5·65	25	0·85	4·91
5	Hamilton	6·66	22	0·88	5·19
5A	Rotorua	8·54	18	1·86	5·24
6	Kawhia	7·54	20	0·82	5·72
7	New Plymouth	10·42	23	1·86	6·14
8	Riversdale, Inglewood ..	15·01	21	2·56	10·31
9	Whangamomona	15·85	19	2·72	7·62
10	Eltham	9·15	23	1·57	5·46
11	Tairua	4·68	16	1·18	7·38
12	Tauranga	5·29	17	1·04	5·42
13	Maraehako Station, Opotiki	6·32	15	1·94	5·99
14	Gisborne	1·15	8	0·52	5·28
15	Taupo	7·23	16	1·55	4·48
16	Napier	0·88	13	0·21	3·59
17	Maraekakaho Station, Hastings	2·94	14	0·74	3·33
18	Taihape	7·39	22	0·90	3·85
19	Masterton	5·08	17	1·28	3·48
20	Patea	6·14	16	1·45	4·15
21	Wanganui	8·01	14	1·80	3·19
22	Foxton	8·40	..	..	2·96
23	Wellington (Karori Reservoir)	6·03	14	2·81	4·63
	South Island.				
24	Westport	10·17	24	1·43	7·53
25	Greymouth	9·77	20	1·20	8·27
26	Hokitika	13·83	20	2·26	9·60
27	Ross	19·87	17	5·84	9·20
28	Arthur's Pass	25·50	12	6·00	10·12
29	Okuru, Westland	20·45	15	5·36	10·76
30	Collingwood	14·20	20	2·27	11·33
31	Nelson	5·10	13	2·42	3·69
32	Spring Creek, Blenheim ..	6·40	12	4·50	3·01
33	Tophouse	12·19	17	2·10	4·75
34	Hanmer Springs	11·19	12	3·78	3·11
35	Highfield, Waiau	3·54	8	1·90	2·49
36	Gore Bay	4·58	12	1·90	2·34
37	Christchurch	3·08	14	1·70	2·66
38	Timaru	5·28	14	2·18	1·70
39	Lambrook Station, Fairlie ..	4.24	12	1·36	1·91
40	Benmore Station, Clearburn	4·08	18	0·82	1·90
41	Oamaru	4·46	16	1·30	2·01
42	Queenstown	2·82	10	0·59	2·46
43	Clyde	1·68	10	0·38	0·98
44	Dunedin	6·94	18	1·89	3·15
45	Wendon	5·02	12	0·96	2·42
46	Gore	4·88	18	1·00	2·82
47	Invercargill	4·40	22	0·85	3·60
48	Puysegur Point	8·69	23	1·35	6·58
49	Half-moon Bay	5·48	18	0·65	4·51

ANSWERS TO INQUIRIES.

IN order to ensure reply to questions, correspondents must give their name and address, not necessarily for publication, but as a guarantee of good faith. Letters should be addressed to the Editor.

DIET OF YOUNG DOGS.

R. J. DIAMANTI, Canvastown :—

Please inform me if raw meat included in their diet has any detrimental effects upon young pups (six weeks old), and whether it has a tendency to make them liable to contract distemper more easily.

The Live-stock Division :—

The diet of a young dog has no direct bearing on distemper, and raw meat as part of the ration does not render dogs more susceptible to that trouble. The basis of a diet for pups six weeks of age should be porridge and whole milk, if available. The protein of milk is more easily digested than that of meat, and young dogs must be gradually brought on to a meat diet. A little meat and a small bone occasionally can also be given, the meat ration being increased as the dog becomes older. In connection with raw meat for dogs it is essential that such meat should be free from hydatid cysts. Livers and other offal should be carefully examined for the presence of cysts. If cysts are present, either reject the offal or do not use it until after thorough cooking. Dogs are infested with tapeworms through eating raw offal affected with hydatid cysts.

FLOWER-CULTURE FOR MAKING OF PERFUMES.

"PERFUMES," Dunedin :—

Would it be possible to grow flowers—say, roses, lavender, rosemary, &c.—for making macerated oils and pomade so much used in the making of perfumes, and which must be imported into New Zealand in considerable quantities. We will be shifting to North Auckland during the next few months, and I should think the climate there would be just as suitable as the south of France and Bulgaria for the purpose mentioned.

The Horticulture Division :—

The growing of flowers and plants in this country with a view to distilling them for the perfumes they contain has been considered from time to time from the point of view of a commercial proposition, but although the soil and climate are sufficiently dry and warm in some parts of the country, the labour and marketing conditions here place us at a disadvantage in competition with European countries engaged in this trade in essential oils. It is doubtless possible to do something in this way here, but the commercial possibilities are not sufficiently attractive to recommend the undertaking. However, should you desire to test the matter it will be essential for you to obtain varieties of plants specially suited for the purpose, and then grow them in a well-drained soil where a warm dry summer season, which is necessary for the maximum production of essential oils, can be relied upon. In a wet climate the yield will generally be very low. The North Auckland country has rather a generous rainfall for the purpose, and the driest district there should be selected for the purpose of any experiment decided upon.

BLOOD IN COW'S MILK.

"SUBSCRIBER," Woodend :—

One of my cows has been giving a quantity of blood in her milk for some weeks. She is a second calver and has been in milk six months. It started in one hind quarter, then it got into a front one. The other two are all right. The udder is in no way hard or painful, and appears quite normal. Would you kindly inform me the cause, also treatment of the condition.

The Live-stock Division :—

This condition is most frequently brought about by small blood-vessels in the udder becoming ruptured owing to an intense congestion of the udder with blood after parturition. The act of milking reopens the injury, and until this heals a varying amount of blood will come away, particularly with the strippings. In this case time alone will remedy the matter, though it would no doubt be of benefit if you went about the milking as carefully as possible and did not strip right out. Another cause of the trouble is a bruise or contusion of the quarter, due to some external injury. The same line of treatment will apply, and in either case a drench may be given composed of ½ lb. Epsom salts, ½ lb. common salt, and 1 oz. ginger, to 1 quart of warm water. If the case does not improve send a sample of the milk to the Officer in Charge, Veterinary Laboratory, Wallaceville. If you do this, the bottle containing the milk, and also the cork, must be thoroughly cleaned and then boiled for several minutes to ensure that they are sterile.

KIKUYU-GRASS.

A. B. BABBAGE, Hauturu :—

Can you tell me anything about kikuyu-grass? One of the settlers here is trying it, and it seems to be doing well, and is much relished by the stock.

The Fields Division :—

Kikuyu-grass, introduced from South Africa, has been grown for the past six or seven years at the Puwera Experimental Farm, near Whangarei, North Auckland, and large numbers of parcels of roots have been forwarded to farmers in various parts of the Auckland Province for trial. The grass is established by planting out roots. When planting on a large scale, the work is lightened by first chaffing the roots, broadcasting the small sections over the cultivated land, and then disking them in. Planting out is best done in the spring. During the first two or three years after establishment the grass throws a large amount of very palatable feed, but as the surface soil becomes filled with the roots the stand becomes sod-bound and production decreases. The grass throws little or no feed in the winter and spring, and is cut back by hard winter frosts. Generally speaking, land areas suited for kikuyu would be better sown in paspalum. However, kikuyu is well worth planting on broken slips, sandy knolls, and other similar places which are difficult to grass.

"COW-GRASS" AND RED CLOVER.

J. T. BRIGHT, Waipukurau :—

Could you inform me whether there is any difference between cow-grass and red clover?

The Fields Division :—

There is no real difference between cow-grass and red clover. In New Zealand the large-seeded better-looking lines are usually sold as cow-grass, and the smaller-seeded lines as red clover. The term "cow-grass" is used to some extent in Britain, the name "double-cut cow-grass" being applied to the Broad Red and "single-cut cow-grass" to the Late Red clover types. There is, however, no legitimate reason for the use of the name "cow-grass," and the effort, both here and in Britain, is to get the term "red clover" used generally, and to eliminate the term "cow-grass" altogether.

LAYING DOWN COCKSFOOT FOR SEED PURPOSES.

D. S. STUDHOLME, Hinds :—

I wish to lay down a paddock of cocksfoot for seed purposes only. Land is free alluvial loam, without clay subsoil, and is infested with fat-hen seed. Should the cocksfoot be sown in spring or autumn? Should it be sown alone,

or are equally good results obtained by sowing with wheat, turnips, rape, or oats? If sown with a fodder crop, will the tramping of the sheep affect the young cocksfoot-plants?

The Fields Division :—

The cocksfoot-seed should be sown on well-prepared land, at the rate of from 20 lb. to 25 lb. per acre. We do not favour the idea of sowing with a cover-crop. Spring sowing is preferable, but in cases where fat-hen is very troublesome sowing is at times deferred till autumn. The autumn sowing frequently strikes dry weather, with the result that the plants cannot establish. In our experience we have found it beneficial to sow white clover, at the rate of 2 lb. or 3 lb. per acre with cocksfoot. Where this is done a better and quicker growth is obtained. Superphosphate should be applied at time of sowing, at the rate of 1 cwt. per acre.

INVENTIONS OF AGRICULTURAL INTEREST.

APPLICATIONS for patents, published with abridged specifications in the *New Zealand Patent Office Journal* from 16th May to 11th July, 1929, include the following of agricultural interest :—

No. 62254 : Fireless brooder ; E. O. Peterson, Upper Hutt. No. 59441 : Wool bale or bag cramp ; R. H. Whisker, Wanganui. No. 59668 : Milking-machine ; W. R. Cockburn, Auckland. No. 61686 : Milking-machine ; Aktiebolaget Separator, Stockholm, Sweden. No. 60635 : Manure-distributor ; M. Higgins, Mercer. No. 60711 : Drying-apparatus for flax fibre ; Maddren Bros., Christchurch. No. 60939 : Flexible stock-brand ; C. G. Teschemaker, Blenheim. No. 61244 : Indicator attachment for milking-machine ; J. Treloar, Hamilton. No. 62351 : Draining tool ; W. B. S. Lindsay, Morrinsville. No. 59603 : Manufacture of monocalcic and dicalcic phosphates from tricalcic phosphates ; J. A. Pond, Auckland. No. 61020 : Producing fibre from flax ; G. E. Field, Palmerston North. No. 62298 : Treatment of cheese ; Kraft Walker Cheese Co. Pty., Ltd., South Melbourne, Vic. No. 62314 : Cream- and milk-cooling device ; F. Prentice, Foxton. No. 61544 : Holding animals while being operated upon ; J. A. Woodley, Aokautero. No. 61647 : Egg-crate ; Turner and Growers, Ltd., Auckland. No. 61777 : Flax-stripper ; H. T. Greedy, Wellington. No. 62566 : Milking-machine ; T. H. Hartstone, Te Awamutu. No. 62770 : Power apparatus for dairy-farms ; General Electric Co., Ltd., London, Eng.

Copies of full specifications and drawings in respect of any of the above may be obtained from the Registrar of Patents, Wellington, price 1s. prepaid.

INTERIM RETURN OF SHEEP AT 30th APRIL, 1929.

Sheep District.	Number of Sheep.		Increase.	Increase per Cent.	Percentage of Total Increase
	Final Return, 1928.	Interim Return, 1929.			
Auckland	2,380,475	2,704,188	323,713	13·59	17·2
Gisborne – Hawke's Bay ..	6,539,179	6,797,342	258,163	3·94	13·8
Wellington – West Coast ..	5,562,451	6,067,679	505,228	9·08	26·9
North Island totals ..	14,482,105	15,569,209	1,087,104	7·50	57·9
Marlborough–Nelson–Westland	1,361,043	1,451,962	90,919	6·68	4·8
Canterbury–Kaikoura ..	5,539,597	5,835,602	296,005	5·34	15·8
Otago	5,751,065	6,154,674	403,609	7·01	21·5
South Island totals ..	12,651,705	13,442,238	790,533	6·24	42·1
Dominion totals ..	27,133,810	29,011,447	1,877,637	6·91	100·0